

Bartholinus Anatomy;

MADE

From the Precepts of his Father, And from the
Observations of all Modern Anatomists, together with his own.

*With one hundred fifty and three Figures cut in
Brass, much larger and better than any have been heretofore Printed in English.*

IN

FOUR BOOKS

AND

FOUR MANUALS,

Answering to the said BOOKS.

Book I. Of the Lower Belly.
Book II. Of the Middle Venter or
Cavity.



Book III. Of the uppermost Cavi-
ties, *Viz.* The Head.
Book IV. Of the Limbs.

The Four Manuals Answering to the four foregoing Books.

Manual I. Of the *Veins*, Answering
to the First Book of the Lower
Belly.

Manual II. Of the *Arteries*, Answer-
ing to the Second Book of the
Middle Cavity or Chest.

Manual III. Of the *Nerves*, Answer-
ing to the Third Book of the Head.

Manual IV. Of the *Bones*, Answering
to the Fourth Book of the Limbs.

*Alſ Two Epistles of the Circulation
of the Blood.*

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The Introduction.



Nthropologia or the Doctrine of Mans Nature, is, though commonly, yet rightly divided into two Parts: *Anatomia* which treats of the Body and its Parts; and *Psychologia*, which treats of the Soul.

Anatomia therefore [more rightly called *Anatomy*, that is *Section*, which Sr. *Ignatius* reckons as a kind of Martyrdom, *Calius* terms *Apertio* an opening, and *Tertulianus Profectio* a cutting up, whence the term *Profeſſor*, a Cutter up] that I may come to that which is my buſineſs; in as much as it is a part of Natural Philoſophy [for Medicinal Anatomy how ever uſeful and of which *Galen* treats in his Anatomical Adminiſtration, we muſt leave to Phyſicians] that for

The Subject of Anatomy.

iss Subject the Body of any Animal or Live-wight whatsoever, whether frequenting the Land or
or Waters, flying in the Air, &c. and not only the Body of Man. But we are wont most of
all to search into the structure of Mans Body. 1. Because of the great Perfection thereof, which

all to search into the structure of Mans Body. 1. Because of the great Perfection thereof, which is the Rule of Imperfection, 2. Because the fundry sorts of Animals are almost infinite, so that to dissect and search into all of them, the life of man in this Age of the World is not sufficient. 3. Because of the incredible profit which thereby redounds to every man, who desires

*Why Anatomy
treats chiefly of
the Body of
Man.*

3. Because of the incredible profit which thereby redounds to every man, who desires perfectly to know himself, and this House of his earthy Tabernacle, both the better to preserve Health and to cure Diseases: Nor can any man be a Natural Philosopher or deserve so to be called, unless he have the Doctrine of Anatomy at his fingers end, above all other Parts of Natural Philosophy. Yet is not the Dissection of other Creatures therefore unprofitable, or to be neglected by an Anatomist, partly by reason of the Analogie and Correspondence they hold with the Body of Man, partly to attain to the Knowledge of the Motions of Living Creatures, and partly, to conclude, for the Exercise of an Anatomist and Surgeon. *Democritus* sought the Seat and Nature of Choler in Living Creatures. After him *Galen* dissected Apes and other Living Creatures, as also *Severinus*, *Aldrovandus*, *Cassellus*, *Brongerus*, *Panarolus* and myself have cut up divers Living Creatures. By the cutting up of Creatures alive *Alexius* found out the true Nature of the Veins, and *Harvey* and *Waleus* found the motion of the Blood.

The Difference
of other Ani-
mals is useful
to an Anatomist
and why?

Moreover, because in regard of the variety of its Actions, the Body of Man does not consist of one part all alike, but of sundry; therefore we must know that the whole Body is divided into Parts containing, Parts contained, and Parts moving, according to the ancient Doctrine of Hippocrates: that is to say, into solid Parts, Humors and Spirits. And in this large accep-

The division
of the rebel Bo-
dy of Men.

[illegible]

What a Pair is ?

1. That which live, is nourished, but does not nourish any other Part. And so they exclude the Spirit, which is also the Fat, which sometimes nourishes the Parts, and the Marrow of the Bone, which is nourished.

What is the proper description of the work?

3. Which hath a proper Circumscription of its own. The contrary whereof is in fat, which is terminated by the figure of the Parts adjacent.

4. Which is continued with the whole, Mathematically and Physically, both in respect of the Matter and Form jointly considered.

¶ 5. Which is fitted for some Function or Use. And so Warts and Swellings, with other things which grow upon the living Body præternaturally, are excluded.

And that we may understand what is meant by Function and Use, I shall briefly open the same. An Action or Function may be either private or publick. The private Action is that whereby the Parts provide for themselves; the publick is that whereby they provide for the whole live Creature. A publick Action as it is opposed to use, is the Action of the principal Part of an Organ which performs the whole Action. For every Action in the Body of a livewright, hath according to *Galen*, a peculiar Particle, by which it is performed. For Examples sake; The Skin hath of it self a private Action, such as the Attraction and Retention of Nourishment, &c. it hath also a publick action for the behoof of the whole Animal, viz. the discerning of the tangible Qualities, such as are perceived by the Sense of Feeling. So the action of the Liver is Food-making, of the Stones, Seed-making; of the Dugs Milk-making.

What is meant
by the Action
of a Part.

But the 2. is that help which the left principal Parts afford the more principal, in the performance of their Actions, which according to *Galen* is in all Parts, yea even in those which have no action at all. It springs chiefly from three Fountaines, and they are,

What by the

I. The proper *Temper* of the Part, that is to say the Symmetry or even proportion of the first Qualities. For Examples sake, The Skin is in respect of the first Qualities temper'd; and if

The INTRODUCTION.

you ask wherefore, I answer, that it may be able to discern and judge of all tangible Qualities.

2. *Such things as follow the Temper*, and they are the second Qualities: Hardness, Softness, Thickness, Thinness, Compactness, Rarity, &c.

3. *Necessary Adjuncts*; as Magnitude, Number, Passages or Cavities, Figure, Conformation, Connexion, Situation, Surface. But I, in these Institutions, for the convenience of Learners, shall, with other Anatomists, seldom observe this accurate difference between Action and Use especially, that I may avoid the tedious repetition of sundry things.

Which Part of the Body is first generated.

But before I proceed to the Division and Differences of Parts, I shall briefly resolve this question, *Which Part of the Body is first generated*. We must therefore know, that according to *Hippocrates*, all the Parts are formed and differenced at one and the same time, as in a Circle, there is neither beginning nor end, but altogether are both beginning and end. But all the Parts are not perfected and adorned at one and the same time; but in the first place the Navil-vein. 2. The Liver. 3. Afterwards the Heart (which *Aristotle* would have to be first made, as *Galen* would have the Liver to be) and lastly the brain. The Navil-vein therefore, is first finished and perfected, in regard of the enlargement thereof by the blood, but not in respect of its first Constitution of the Seed. But others said that the Groundwork or underwarpe of the Parts is Seed, and the Wool or Superstructure blood, supposing that there are two material Principles of the body: Seed and blood. Which Opinion I have refuted and sufficiently explained in my *Anatomical Controversies*, *Quest. 11. touching the Parts and their Faculties and Functions*.

Why the Vessels were to be made before the Bowels.

And therefore the Vessels are laid in respect of Perfection to be generated before the bowels, and that justly. For otherwise the bowels could not be nourished without a proportionable Instrument to that end, namely a Vein, by which the blood is conveyed for their Nutriment. For as out of a Kernel or Seed put into the Earth, first a long Root descends into the Earth, after that other Roots spread themselves round about the Surface of the Earth, out of which afterwards, the Trunk and branches spring up; so out of the Seed committed to the Womb, there arises first the Navil-vein, receiving blood out of the Womb-cake; out of which Navil-vein arises the *Vena Porta*, with its Roots.

Division of the Parts.

Let us now come to the Division or Differences of the Parts, which may be divers. Taking the word in a large Sense, some divide them into parts of *Necessity*, as the Heart, Liver, Lungs, Stomach; and Parts of *Commodity*, and that either great as the Eyes and Stones, or less as the Nails; and parts of *Ornaments*, as the Hairs of the Head and Beard.

In respect of their End.
The principal Parts.

But I shall divide the Parts, chiefly in respect of their *End*, or in respect of their *Matter*. In respect of the *worthiness of the End*, some are *Principal*, others less principal and *servient*. The *Principal* are the Liver, Heart, Brain, which are the Principles of other Parts. As, out of the brain arise the Nerves, according to the common Opinion, out of the Heart, the Arteries, out of the Liver, the Veins. Others add the Testicles, but without any need, because they make nothing to the Conservation of the Individual, and Generation is caused without them, as I shall shew by Examples in the 7. Book Chap. 22.

The Beginning or principle of Radication.
The Original of Dispensation.
Parts subservient or ministering.

Now we do not mean the beginning of Radication or Original; for so, the Seed is the beginning of all the Parts, but of Dispensation and Distribution; that is such a beginning as sends out of it self some Instrument, Force or common Matter. So from the Heart, as the beginning or Original of Dispensation, the Arteries arise, because they receive their Virtue from the heart, and seem there to have their Original. The same may be said of the Veins and Nerves in respect of their Originals. So the Gristles have their Original from the bones, and also the Ligaments.

The *Subservient Parts* are *necessary or not necessary*.

The *Necessary* are those without which the Animal cannot live well. So the Lungs serve the Heart, the Guts the Stomach; the Stomach, Liver and Spleen; the Gall-bladder, Choler-passage and Piss-bladder, serve the Liver; and all the Instruments of the Senses serve the brain.

The *Not-necessary*, as simple flesh, &c. in respect of other Parts: for in consumptive persons it is wasted away, and in fleshy persons it is a burthen, and insects according to *Aristotle* have no Flesh.

In respect of their Matter.
A similar part what it is, and how manifold.

In respect of their immediate Matter, some are simple, Homogeneous or Similar; others Compound Heterogeneous, or dissimilar.

A *Similar Part*, is that which is divided into Parts like it self, so that all the Particles are of the same Substance with the whole, as every part of flesh is flesh, &c.

Of such similar Parts, some reckons more, others fewer.

Aristotle in sundry places, thus reckons them: Blood, Flegm, Choler, Sanies or blood-water, Milk, Seed, Gall, Fat, Marrow, Flesh, Veins, Arteries, Nerves, Fibres, Membranes, Skin, Bones, Gristles, Hairs, Nails, Horns, Feathers.

Averroes omits some of these, and adds Melancholy, Spirits, Muscles, Cords, Ligaments, Suer.

Galen in sundry places, thus reckons them: A Bone, a Gristle, a Vein, an Artery, a Nerve, a Membrane, a Fibre, a Tendon, a Ligament, a Nail, Skin, Fat, Marrow, the Glasse and Chrystalline Humors, the flesh of the Muscles and bowels, with the proper substance of the brain, Stomach, Guts and Womb.

Archangelus retains all the aforesaid, and adds three sorts of Spirits, four Alimentary humors, and the Excrementitious humors, as Urin in the Bladder, Choler in the Gall-bladder, Excrementitious Flegm, and all the Excrements of all digestions, the Scarf-skin, and the internal Skin of the upper Cavities. Moreover he adds to these, seventeen similar parts, not commonly

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ly reckoned, viz. the proper substance (setting aside the other similar parts, Veins, Arteries, &c.) of the Brain, Tongue, Lungs, Heart, Liver, Gall-bladder, Spleen, Stomach, Guts, Kidneys, Ureters, Piss-bladder, Womb, Yard, Stones, Muscles, Kernels. But it is in Vain for him to reckon these parts as new : for all in a manner are comprehended under Flesh. For according to *Hippocrates* and *Galen*, there is a flesh of the Muscles, and a flesh of the Bowels, and a flesh of the Glandules or Kernels. But in another place *Galen* propounds a threefold flesh. 1. In a Muscle, which the *Ancients* did only call Flesh. 2. The *Parenchyma*, or proper substance of the Liver, Heart, Kidneys, &c. 3. In the Stomach, Bladder, Veins. 4. In the Bones, though improperly.

Whence we may gather four sorts of Flesh. 1. Musculous flesh, which *Galen* frequently terms Fibrous flesh, and it is soft and red and properly termed flesh. And in *Hippocrates* his Language, by flesh many times is meant the Muscles. 2. Viscerous flesh or the flesh of the Bowels. *Erasistratus* calls it *Parenchyma* or an Affusion of blood; *Galen* calls it Similar and simple flesh, which supports the Vessels of the bowels, fills up the empty spaces, and performs the Action. 3. Membranous flesh, or the fleshy substance of every Membranous part, as in the Gullet, Stomach, Guts, Womb, bladder. 4. Glandulous flesh, or the flesh of Kernels, which serves. 1. For to support the divisions of Vessels. 2. To drink up superfluous humors, especially wheyish humors, because the Kernels are of an hollow Spungy substance; and therefore they are vulgarly termed *Eminories* or Clenfers. Those in the Neck being counted Clenfers of the Head; those in the Arm-pits, of the Heart; those in the Groyns of the Liver. 3. To moisten the parts for their more easie motion, or otherwise to prohibit dryness. Such are those which are situate by the Tongue, Larynx, Eye-corners, &c.

But the similar parts are reckoned to be *ten* : A bone, a Gristle, a Ligament, a Membrane, a Fibre, a Nerve, an Artery, a Vein, Flesh and Skin.

Of these some are similar only in the judgment of Sense, as Veins, Arteries (some add Muscles) others are simply and absolutely similar. That Veins, Arteries, Nerves, Muscles are not truly simple and similar, hath been rightly taught by *Aristotle* : for a Muscle consists of *Flesh, Fibres, and a Tendon* : Nerves are made up of the *Dura and pia Mater*, with Marrow : Arteries, of two different coats; the Veins of a coat (and of Fibres as some will have it) and Valves. Simply and truly similar parts are Bones, Gristles, Ligaments, Membranes, Fibres, Flesh and Skin. To these some add the Ureters, the Air implanted in the Ear, &c. but in vain. For, 1. They are not parts common to the whole body, but proper to some parts. 2. The implanted Air of the Ears, is nothing but an implanted spirit, which cannot be reckoned among solid parts.

Here we are to observe that all these parts are commonly divided, into *Spermatical, Sanguine, or mixt*.

The *Spermatical* are made of seed, and such are the eight first reckoned; which if they are cut asunder, they breed not again, nor can they be truly united, but they are joyned together by a Callus in the middle, by reason of defect of matter and formative faculty, which acts not after the Conformation of the Parts.

The *Sanguine* or fleshy Parts, contrarywise are bred again, because they are supposed to be made of Blood, as the Flesh.

A mixt Part is the Skin, of which we shall treat hereafter, in *Book I. Chap. 2.*

For feed and blood are commonly accounted the two general Principles of which we are made : so that in the Seed there is very little of the material principle, but much of the active, but in the blood much of the material principle, and but a little and weak portion of the active or effective principle. The first Rudiments and underwrap as it were of the parts, are said to be made of Seed; and the woof or superstructure of blood flowing in. But what the Truth is in Contradiction to this vulgar opinion, we have taught in our *Anatomical Controversies*. For we are rather to hold, that the parts are at first made only of Seed, as of their matter; and that the Mothers blood doth nourish, and encrease and amplify the Parts. The Skin in comparison to other Parts, hath an indifferent proportion of Seed, not so much as the *Spermatical*, nor so little as the *Sanguinary* parts.

The Compound or *dis-similar Parts* are, those which may be divided into divers unlike parts; as an Hand cannot be cut into other Hands, but into Bones, Muscles, Veins, &c. The *dis-similar* parts are by the *Phylosopher* called Members : but they are vulgarly termed *Organical* or instrumental parts.

Now in every Organ, there are for the most part, four kinds of parts. For example sake, in the Eye there is, 1. That part by which the action, viz. Seeing is performed, namely the *Crystalline Humor*. 2. That without which it cannot be performed, as the *Optick Nerve*. 3. That by which it is the better performed, as the *Coats and Muscles* of the Eyes. 4. That by which the action is preserved, as the *Eye-lids*, &c.

And because the *Dis-similar* parts are more or less Compounded, they are divided into four degrees or ranks.

The 1. Is such as are similar to the sense, as a Muscle, Vein, Artery. The 2. Is made of the former and the rest of the similars, as a Finger. The 3. is compounded of the second, as an Hand, Foot, &c. The 4. Is compounded of the third, as an Arm or Leg.

Finally the Body is divided into its greatest Members, as by some into the Head, Chest, Belly and Bladder; by others as *Aristotle, Ruffus* and *Oribasius* into the Head, Neck, Chest (under which they comprehend the lower Belly) and therefore *Hippocrates* placed the Liver in the Chest the one

How many
sorts of Flesh
there are?

The Number
of the Similar
Parts.

What a Sper-
matical Part
is?

What a Sanguine
Part.

What a dis-similar
part is?

Organical
parts.

con-
vulsi-

Acute Body

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Arms and the Legs. But others have better divided them into the *Bellies* and *Limbs*.

The *Bellies* are certain remarkable Cavities of the Body, wherein some noble bowel is placed : and as there are three principal Members, so are there *three Bellies* : the *lowest* belly, commonly called *Abdomen* or the *Paunch*, contains the *Liver* and *Natural* parts. The *Middle* or *Chest*, contains the *Heart* and *vital* parts. The *uppermost* or *Head* contains the *brain* and *Animal* parts. The *Limbs* which were given us for more conveniency of living, are the *Arms* and the *Legs*.

And therefore we shall make four books : 1. Of the Lower belly. 2. Of the Middle belly. 3. Of the supream belly or Cavity, the *Head*. 4. Of the *Limbs*. And to these shall answer four *Petty Books* : The *first* of the *Veins* which arise from the *Liver* in the lower Cavity. The *second* of the *Arteries* which arise from the *Heart*, in the middle Cavity. The *third* of the *Nerves*, which are commonly thought to spring from the *brain*. The *fourth* of the *bones*, which are most what in the *Limbs* : and as the *bones* joynted together make a compleat frame and bodies as it were ; so also do the *Veins*, *Arteries*, and *Nerves*.

We may find another division of the body in *Fernelius*, which nevertheless is of no use save in *Physick*. He divides the body into *pulpsike Regions* and *Private*.

Private Regions he calls the *brain*, *Lungs*, *Kidneys*, *Womb*, &c. *Publick* or common he makes three extended through the whol body. 1. Hath the *Vena porta*, and all the parts whereinto its branches are spread. 2. Begins at the *Roots of Vena Cava*, and is terminated in the *small Veins*, before they become *Capillary*. 3. Hath the *Muscles*, *Bones*, and *Bulk* of the body and ends in the *Skin*.

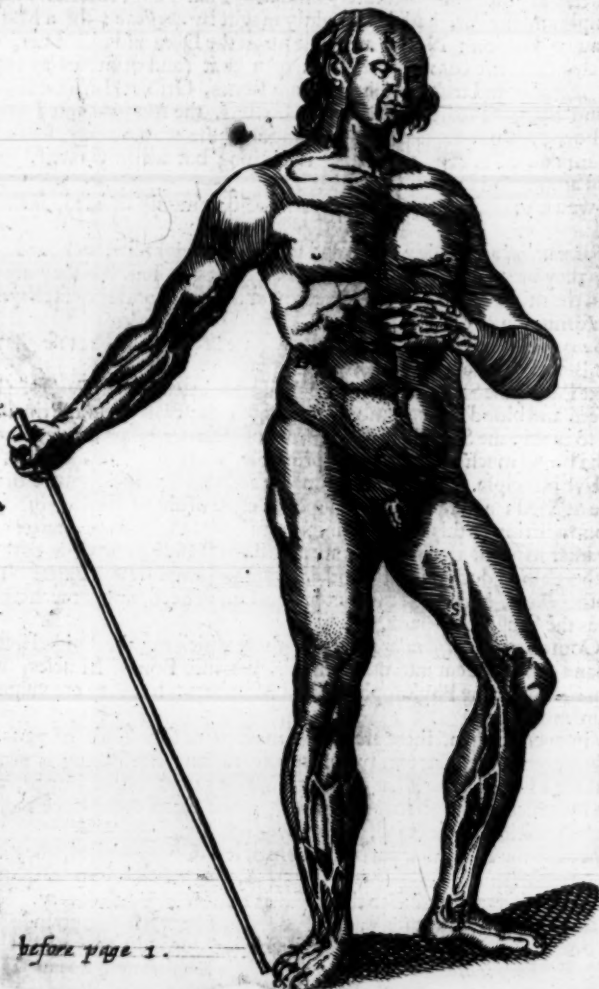
We purge the *first Region* chiefly by the *Guts* ; The *second* by the *Urinary passages* ; The *third* by the *Pores of the Skin*.

The Explication of the FIGURE.

This **T A B L E** holds forth the *Portraiture* of a *Living Man*, wherein both the *external* parts of the *Abdomen*, as all the *Conspicuous Veins* which are wont to be opened by *Chirurgeons*, and the places where *Issues* are wont to be made, are *Represented*.

- A. The *Hypochondrium*.
- B. The *Epigastrium*.
- CC. The *Hypogastrium*.
- D. The *Flanks*.
- EE. The *Groins*.
- F. The *Region of the Shave*.
- G. The *Navil*.
- H. The *Heart-pit*.
- I. The *jugulum* or *ballow of the Throat*.
- K. The *Forehead Vein*.
- L. The *Temple Veins*.
- M. The *jugular Veins*.
- N. The *Cephalica Vena*.
- O. The *Basilica Vena*.
- P. The *Mediana* or *common Vein*.
- Q. The *Head vein of the left Arm*.
- R. The *Salvatella*.
- SSSS. The *Saphena Vein descending*.
- T. The *Saphena Vein in the Foot is self*.
- V. The *Sciatica*.
- XX. The *Issues in the Thigh*.

The I. TABLE



before page 1.

THI



THE FIRST BOOK; OF THE Lower Belly.

The Reason of the Order. Why Dissection is begun in the lower Belly.

Crements may be the sooner removed, and the Body preserved from putrifaction.

What the lower Belly is.

The Parts of the lower Belly, and their Names.

It is all that, which is distinguished, within, from the Chest by the Midrif; it is circumscribed by the sword-like Gristle, the Share bones, Hip-bones, *Os Sacrum*, the *Vertebra's* of the Loynes, and the bastard Ribs on either side.

The former part thereof is called *Epi-gastrium*, which compasses the stomach and guts next unto it. The Arabians call it *Mirath*, which generally is used for the Belly, but in a particular sense it is taken for those wrinkles of the belly, which remain after child-bearing, and for the skin gathered together upon the belly, as *Giggeus* informs us.

And the upper part hereof is termed *Hypochondrium*, neighbouring upon the lower gristles of the Ribs, and it is right or left: some term them *Phrenes* and *Præcordia*.

The middle Region is termed *Regio umbilicalis*, whose lateral parts *Aristotle* calls *Lagonas* by reason of their Laxity, and *Galen*, *Cenentmas* from their emptiness.

The lower part which reaches from the Navil to the Share, is termed *Hypogastrium*, by *Hypocrates*, *Galen*, *Ruffus*, *Pollux*: the Latins term it *Imus venter* and *Aqualiculus*. The lateral parts thereof, are termed *Ilia*; and in the bending of the thigh by the Share *Inguina* the Groyns; and that part next over the Privities, which is covered with Down or Hair, is called *Pubes* the Share.

The hinder part of the lower Belly, is either the upper, which makes the Loynes; or the lower, which makes the Buttocks.

Moreover this Belly consists of parts covering and covered, that is to say *External* and *Internal*.

The covering or *Containing* parts (which they properly call *Abdomen*) are either common, as the Scarf-skin, the Skin, the Far with its Membrane, the fleshy Pannicle, and the Coat proper to every Muscle; or proper, and they are the Muscles of the *Abdomen*, the *Peritoneum*.

The inner or *contained* parts, do serve either for *Nutrition* or *Procreation*.

For *Nutrition* or making of Chyle, are subservient more or less, the Stomach, the Caul, the Sweet-bread, the Guts with the Mesentery: to the making of Blood, are subservient more or less, the Meseraick Veins, the *Venæ portæ* with their Roots, the Cava with its Roots, the Liver, the Gall-bladder, the Gall-passage, the Spleen with the *Vas breve*, and the Hæmorrhoides, the *Arteria Cæliaca* the Kidneys, the *Capsula Arabiliarie* or black choler boxes, the Ureters and the Piss bladder.

Those which serve for Generation, are either Masculine or Female: the Masculine are, the Spermatick Vessels, the *Corpora Varicosa* or *Parastata*, the Stones, the carrying Vessels, the Prostrata, the Seminary bladders, the Yard, &c. The Female are, the Spermatick Vessels, the *Corpus Varicosum*, the Testicles, the Ejaculatory Vessels, the Womb with its parts, &c.

But when a Man is in the Womb, there are yet other things considerable, as the Navil-vessels, the coats which infold the Child, &c. of which in their place.

CHAP. I. Of the Scarf-Skin.

The *Cuticula* or Scarf-skin, in Greek *Epidormis*, is by some called the highest or last skin, also the cream of the skin, the cover of the skin, &c. It is a thin skin void of life and sense, close-compacted, bloodless; bred of Oyle, sleek and clammy vapors thickned by the external cold, that it might be a cover to the skin.

The Matter of which the Scarf-skin is made, is not seed. For 1. It is no part of the Body. 2. It is not nourished. 3. A Spermatical part taken away breeds not again; but the scarf-skin is easily lost by rubbing and wearing, or being raised into blisters, by burning with Fire or scalding Water, &c.

Nor is the matter thereof Blood, For 1. All Veins do end at or within the skin. 2. It hath no spermatical Fibres, which are of all sanguine parts. 3. It is the last

All the Parts which are to be examined in this Book.

The Scarf-skin.

What it is.

Whether the Scarf-skin be made of seed?

Or of Blood?

and Consumptions, it many times grows thick. 4. Being cut or torne, it sends forth no Blood. 5. It is not of a red color, &c.

Or of the Excrement of concoction.

Nor are the Excrements of any Digestion, the matter thereof. Nor the Excrements of the first or second digestion; for how should it be made of Dung, Urin or Gall? Nor the Excrements of the third. For the third Digestion or Concoction hath a threefold Excrement. 1. Vaporous and thin which Expires. 2. Thin, but more solid then the former, of a waterish substance, such as are Ichors and Wheyish humors, which by their sharpness and Acrimony, would sooner hinder the Generation of the Scarf-skin, or corrode the same after it is generated.

Laurentius and Archangelus confused.

3. Thick, Clammy, and sticking fast, which Archangelus and Laurentius do suppose to be dried and turned into the Scarf-skin, and they demonstrate the same from the filth which is, in bathing, scraped from the soles of the Feet. And if their opinion were true, the Scarf-skin would come off in Baths.

The true matter of the Scarf-skin.

And therefore the matter thereof is another Excrement, viz. an Oyly, Thick, Clammy, and moist vapor (for of dry Exhalations the Hair is made) proceeding from the Skin and Members under the same. So we see in a Skillet of Water-gruel, a Skin grows over the top of the Gruel, being mad, of the vapors thereof ascending, condensed by cold.

Now the Scarf-skin is bred, partly in the womb with the Skin, and partly without the Womb. Within, For 1. So there are the rudiments and beginnings of Hair, Teeth, Nails in the Child in the Womb. 2. Without the Scarf-skin, the skin would be moist, and the Humor would sweat out with pain, as in gallings and where *Phoenigmi* are applied. 3. Experience shews, that the Scarf-skin is somewhat apparent in an Abortion, and may be separated by some fretting Humidity. But while the Child is in the Womb, it is exceeding tender, soft, and but as yet begun to be made: because there is not in the Womb so much cold, only a small degree springing from the serous humor which surrounds the Child. But it receives its Complement and perfection without the Womb, from the coldness of the Air, which doth more condense and dry, which is the Cause that the skin of all New-born Infants looks red.

The Efficient Cause thereof.

Wherefore the remote and internal Efficient thereof is in the inward heat of the Body, thrusting forth a vapor into the surface thereof, as Exhalations are made by the suns heat. The next and external, is the coldness of some body, as the Air, &c. compacting, and thickning. So Gruel, Hor milk, and other hot dishes of meat, have a skin growing over them: sometimes also the dryness of the Ambient Air, consuming the external humor, and compacting the remainders of the matter. Now by how much the said vapor is more Earthy and Clammy, by so much more solid is that which is bred thereof.

The Use thereof is to defend the Skin. And therefore 'tis somewhat hard, howbeit exceeding thin and yet transparent, like the transparent skins of Onions; least if it were thicker, the skin should not feel if it is sometimes hard and bramy, in the Hands by reason of Labor and Travel.

and more compact than

And therefore it is that watery pustules pass through the Skin but not the Scarf-skin. Yet not over close and compact, least it should hinder the bodies transpiration And it is close wrought; not only to defend the parts under it but that also too great an efflux of Vapor, Blood, Spirit and heat might not happen. For it is the cover of the Mouths and extremities of the Vessels. And therefore those cannot live in good health that are born without a Scarf-skin; as was seen in *Lemes* the King of *Bohemia* and *Hungaria*, who became gray hair'd while he was but a Boy.

It is of a white color, and therefore of a cold and dry temper and quite void of Blood, For being torn or cut, it sends forth no Blood. Nor is it nourished by Blood, as

The color of cold and dry temper and quite void of Blood, For being torn or cut, it sends forth no Blood. Nor is it nourished by Blood, as

Lauremburg and *Sperlinger* would have it; for it is not intrinsically nourished by attraction of its proper Aliment; but by addition of parts. the vapor growing into the like nature of the Scarf-skin, as *Cassius* rightly disputes. The Scarf-skin is black in Blackmores, but not the skin beneath it.

As for number: there is but one Scarf-skin; only there was once two found by

Its number.

Aquapendent: the one being strongly fastened in the pores of the skin, and inseparable: the other separable without offence to the skin. Which happens in some only, not in all parts of the Body. Also *Lauremburgius*, in applying Vescicatories, found the Scarf-skin double; but that is a rare case, for that Vescicatories do peitce unto the skin is apparent from the humor dropping out, and the pain. In brawny Callosities, indeed there are many little skins, as it were the skins of Onions; but they are besides nature, whose Generation and cure is delivered by *Fallopius*.

In point of Connexion, it sticks so close to the Skin of a man, while he is alive, as if it were one continued body therewith. Yet many times it is cast off as snakes and serpents cast their skins, which *Felix Platerus* tells us did happen to himself; and which happens in burning Feavers and the small Pox. *Salmuth* observed as much in some Gouty persons, in an Ague, and some other cases. In dead persons 'tis separated by a Candle, or scalding Water: in living Bodies with *Phoenigmi*. In the Nut of the Yard, it sticks not to the skin, but to the flesh.

CHAP. II.

Of the Skin.

Vis, the skin, is in Greek call'd *Derma*, as it were *Desma* a band; it is the common covering of the Body; or a Temperate Membrane bred of the feed by a proper faculty, to be the Instrument of feeling, and to defend the parts beneath it.

What the Skin is?

It is called a Membrane, which must not be understood simply, but so as to be a Membrane of a peculiar nature and proper temperament. And therefore *Piccolbomineus* was mistaken when he would have the skin to be simply a Membrane; for the skin is thicker, hath a substance proper to it self, and is temperate.

But the opinion of others is, that the matter hereof is Seed and Blood well mixed together, so that the skin hath a middle nature between Flesh

Nerves. And therefore Galen, that it is as a Nerve endued

Galens Opinion touching the matter of the skin.

endued with blood : he sayes not simply, but as it were. For he also likens it to a Membrane, because in some parts it may be extended, feels exquisitely, and is white.

Aristotles Opinion. *Aristotle* would have the skin to consist of flesh dried and grown old as it were. But the skin is easily flaid from the parts under it, and between the flesh and skin there is fat, a Membrane, &c. to which *Opinion Fermelius* inclined, when he said that the skin of the Face was a certain more dry portion of the flesh beneath it. Wherein he also is to be blamed, Because 1. It may be separated from the flesh. 2. It will admit of Scars as the skin in other places.

The Opinion of others. Others say it is made of the Extremities of the Vessels widened, because it every where lives and feels, and the extremities of the Vessels end thereinto : but this may be said of all the parts of the Body.

Others, of the softer Nerves spread out in the surface of the Body, an addition of blood concurring : but this Opinion is of no more force then the former.

The true matter of the skin. The skin therefore is made of Seed taken in a moderate quantity : and for its enlargement, it had a moderate quantity of blood ; but seed seems to hold the greater proportion. For the skin is naturally whitish ; though it varies according to the plenty of humors and Bodies beneath it. For such as the Humor is, such will be the color of the skin. So Sanguine persons have it ruddy ; those that are jaundized, have it yellow or black. Examples whereof see in *Marcellus Donatus* and others. If flesh lie beneath it, the redder it is, if far the whiter.

A Scar, what it is ? It is in respect to the seed, that Authors say, the skin grows not together again after it is wounded. In respect of the blood, there is somewhat like the skin produced, viz. a Scar : Which consists as it were of burnt and dried flesh. Howbeit in Children, by reason of the moisture of their skin, as also the abundance of glutinous humors, a wound hath been observed to be closed up with true skin ; *Winefs Spigelius*.

Wherefore the skin being made as it were of a Membranous, cold and dry, and of a fleshy, hot and moist substance ; becomes temperate in all the first and second qualities, that it may rightly judg of all.

The efficient cause of the skin. The Efficient Cause of the skin, is the Skin-generating faculty ; as in a bone the Bone-generating faculty, in a Nerve the Nerve-forming power or faculty, &c. which faculty frames a part differing from all other similar parts. But how doth the faculty make of the same Seminal matter Nerves, Bones, &c. by an hidden and divine power as it were.

The Action of the skin. The publick Action of the skin, and which is necessary for the whole Living-Creature is, to be the primary Instrument of the sense of feeling, for every Membrane is the Adequate Organ, as may be seen in the Bones, Nerves, Stomach, &c. For though all the Organs of the senses are dissimilar parts, yet one similar part is the primary cause of the action, which is to be performed by the whole Organ. For examples sake, the hand is indeed the Organ of feeling, and especially that part of the skin, which covers the hollow of the Hands and Feet, as being of all other most temperate. And because the skin is temperate in the first qualities, it is therefore also temperate in the second, as for hardness, thickness, thinness, &c.

The first use of the Skin is, to be a Covering for the Body, and therefore it hath received a Figure so round, long, &c. as the subject parts required ; and therefore also it is seated without the Body, and because it was to be as it were the Emunctory of the Body. The professors of Physiognomy commend unto us another use of the skin, as it is streaked with lines ; who are wont to tell mens Fortunes from the Lines and Hillocks in their Hands, and from the Planetary and Adventitious Lines in their Foreheads. A third use is Medicinal, being good for Anodine Emplasters. Being dried, it helps women in Labor ; Epileptick Convulsions, according to the experience of *Hildanus* and *Beckerus* ; Wounds of the Scalp, according to *Poppius*. The fourth is more illustrious, that it might give way to Excrements, and exclude insensible sooty Fumes by way of insensible Transpiration, by which we are more disburthened then by all our sensible Evacuations put together. By this, *Sanctorius* through the statick Art, in the experience of thirty years, did learn that many persons in the space of one natural day, do void more by transpiration, then in fifteen dayes together by stool. The fifth is to attract. 1. Air in transpiration, in Apoplectick and Hystrical fits, and in such as dive deep and bide long under the Water. 2. Juice, in long fasting, from plasters applied, if we credit the Observations of *Zacutus Lusitanus* ; and the force of purgative and other external Medicaments. And for this cause.

It is bored through in divers places, for the ingress and egress of things necessary. Now its holes are some of them visible, as the Mouth, the Ears, the Nostrils, &c. others invisible and insensible, as the pores. Those pores of the Body, being otherwise not Conspicuous, are seen in the winter, when the Body is suddenly bared ; for then the Scarf-skin looks like a Goose's skin when the feathers are pul'd off. By reason (it seems) of these pores it was, that a certain *Persian King* made use of the skins of Men for windowes, if we may credit *Orabasis*.

The Skin is thick, six fold thicker then the Scarf-skin, but thinner then it is in other Animals, nor must any one judg of the thickness of the Skin after it is made into Leather, for by Tanning it is much contracted and thickned, And it seems to be made lighter, for a Maus skin Tanned according to the Observation of *Lofelius*, weighs four pounds and an half.

It is soft and exquisitely sensible, but softer and thinner in the Face, Yard, and Cods ; harder in the Neck, Thighs, soles of the Feet, Back ; of a midling constitution between hardness and softness, in the tops of the Fingers. So, some part of the skin is extream thick as in the Head, according to *Aristotle*, falsly cited by *Columbus*. Some is thick, as in the Neck ; some thin as in the sides, whence proceeds tickling ; some yet thinner as in the Palms of the Hands, some thinnest of all, as in the Lips. In Children 'tis more thin and porous then in grown persons, in women then in men ; in an hot Countrey, then in a cold. Also the Skin is more rare and open in the Summer then in the Winter ; and therefore it is that the skins of Animals flaid off in the Summer do more hardly retain their hair, then such as are flaid off in the winter. Also it varies very much according to the diversity of the subject ; so that in some it hath been of an admirable density and thickness, if we beleave *Petrus Serapion*, who tells of two Negro women, that could without hurt take up, carry, hold, and almost extinguish burning coles with their bare Hands. *Fallopious* saw the skin of a man that he lost his feeling of the Nerves

Its Connexion.

As to its *Connexion*: some skin is easily separated from the parts under it; as in the lower and middle Belly, in the Arms and Thighs. From others with more difficulty by reason of the thick Membrane to which it is fastned by the Fibres, and by means of the Vessels. In the soles of the Feet and Palms of the Hands, it is hardly separated, to which parts it grows that they might lay the faster hold. Also hardly from the flesh of the Forehead and of the whole Face, especially of the Ears and Lips, by reason of tendons and Muscles mixed therewith, especially the Muscle *Latus* so called, mingled therewith. So, in the Forehead it is moveable, and in the hinder part of the Head of some People by reason of peculiar Muscles; but it is not so in the rest of the Body.

Its Vessels.

The skin hath received common Vessels, for Nourishment, Life and Sense. It hath received two cutany Veins, through the Head and Neck, from the Jugulars; two through the Arms, Breast and Back, from the Axillaries; two through the lower Belly, Loyns and Legs, from the Groyns, which are Conspicuous in women after hard Labor, and in such as have the Varices in many branches. It hath few Arteries. And those very small, in the temples and Forehead, Fingers, Cod and Yard. It hath no Nerves creeping in it, but it hath many ending in it, as *Galen* conceived: though *Iobannes Veslingus* the prime Anatomist of *Padua* sayes there are very small branches of Nerves running through the skin: and that rightly, for their preface was necessary to cause the sense of Feeling.

CHAP. III.

OF FAT.

What fat is? **F**AT is a similiary Body void of Life, growing together out of Oyly blood, by reason of the coldness of the Membranes, for the safeguard of the whole Body. That it is void of Life, appears in that it is cut without pain, and Consumptions thereof shew as much. Therefore *Pliny* writes that living sowes are gnawn by Mice; and *Alian* reports that the Tyrant *Dionysius* was so Fat, that when he was a sleep, the pricking of Needles could not awake him. Also in *Greenland* they cut fat out of living Whales which they never feel nor perceive.

The difference between Pinguedo and Adeps.

Pinguedo fat, which the Greeks term *Pimele*, is by *Gaza* ill translated *Adeps*: for *Pinguedo* is an Aiery hot and moist substance of the moister sorts of Animals, and is more easily melted with heat, and will scarce ever become hard again, nor can it be broken, and it is soft, laxe and rare: but understand the contrary in Suet, which easily grows hard and stiff, but is hardly dissolved, &c.

Fat is not a part of the Body.

Now fat to speak properly, is not a part, but rather an humor, unless haply it be considered together with the Membrane, as many times it is by *Galen*.

The of our order is this; because fat in a man is between the skin and the fleshy Membrane, in the under the Membrane which moves the

Those parts are void of fat, which could receive no profit thereby but hindrance by resisting convenient Complication and Distension, as the Brain, Eyelids, Yard, Cod, and Membranes of the Testicles. Now it is chiefly in those parts which are more strongly moved then the rest, hard like Suet, and interwoven between the Fibres and little Veins, as in the Palm of the Hand, the inner sides of the Fingers (for there are many tendons, Nerves and Vessels, which ought to be moistened) in the sole of the Foot, especially the Heel. It is softer in sundry parts, of which in their place.

Caelius Folius hath lately written that the matter whereof fat is made, is the milky juyce, or fatter portion of the Chylus, and that therewith the Bones are nourished. To which opinion I oppose. 1. That such as eat fat meats, do not presently grow fat. 2. That the Chylus is too crude to nourish the parts. 3. That Children should presently become fat as we see it happen in Children new born, who have been nourished only with their Mothers Blood. 4. That the Chylus is necessarily changed before it come unto the Parts. 5. There is no passage from the Mesentery to the extrem parts of the body; for it is neither sucked through the Membranes, as some learned men suppose, nor is it carried through the Glandules. Not the former. 1. Because they are thicker, then to suck and draw as threads. 2. They would appear swoln, and would in Anatomy discover some Oyly moisture in them. Nor the latter, 1. Because the Kernels are not continued with the fat parts. 2. Nor do they receive any profitable humor, but Excrements, yea they abound with a white, flegmatick, but not a fat humor. 3. We observe that many creatures grow fat which have no Kernels. Now the fatter part of the Chyle is the material cause of fatness, but it is only the remote cause, and therefore in deed and truth,

The Matter thereof is Unanimously concluded to be Blood, whence *Aristotle* sayes, that such Creatures as have no Blood, have neither Fat nor Suet: but it must be blood Purified and Absolutely concocted, nor yet all such blood, but that which is thin, Aiery and Oyly. It resembles the buttery substance of Milk, and the Oyly substance of Seed; and therefore *Aristotle* did well deny Fat to be moist; with a watery moisture, his meaning was, not with an Aiery. Against whom *Fernelius* and *Columbus* have written. And when fat is made of Oyly Blood, much of the heat is lost. Whence *Aristotle* sayes; Such things as are condensed by cold, out of them much heat is forced and squeezed. And in another place: Natural matters are such, as the place is wherein they are.

Therefore the nature of Fat is colder then that of blood, yet is it moderately hot; For 1. Outwardly applied, it Digests, Resolves, Diffuses. 2. It is the thinner and more Oyly part of the blood. 3. It easily takes fire. 4. It encreases the heat within, as the Caul assists the Stomachs Concoction, &c.

Some will have it to be cold, because *Aristotle* sayes, whatever things grow together by cold, and are melted by Heat, are cold. But Fat is congealed by cold. I answer: Fat is cold in respect of the Heat which before it had, while it was blood. But we must learn the same *Aristotle*, that such things as having been cold, are melted with an easie Heat, have

what parts have Fat, and what not.

It is not made of Chyle.

But of Blood.

That blood is Aiery and oily

Fat is colder then Blood, yet moderately hot.

The

In this TABLE are expressed the common Coverings of the Belly separated, and on one side the Fat besprinkled with its Vessels, and on the other side certain Muscles Detected,

The II. TABLE.

The Explication of the FIGURE.

- AA. The Scarf-skin.
 BBBB. The Skin.
 CC. The Fat out of its place, separated from the Pannicle or Coat.
 DD. The fleshy Pannicle.
 EEEEE. The Fat left in its proper place half the Belly over.
 FFFF. The distribution of certain Vessels through the Fat.
 G. Store of Kernals in the Groyne.
 HH. The White Line.
 I. The Navil.
 K. Part of the PeRoral Muscles Detected.
 LLL. The Productions of the greater Fore-side-saw-Muscle.
 MM. The oblique descendent Muscle of the Breast in its Situation.
 NNN. The right Muscle of the Belly appearing through the Tendon of the oblique descendent.
 OOO. The Nervous Inscriptions of the right Muscle.
 P. The Right-side Pyramidal Muscle in its proper place.



page 5.

The efficient, or Generating Cause of Fatness, is moist and temperate Heat, the Author of all Digestion. The cause Efficient of its growing together, is the coldness of the Membranes (from whence it gains its white color) not simple but respective; yet sufficient to coagulate the oylie part of the blood sweating forth, even as melted Lead grows congealed, when it is poured out into a place hot enough, yet colder then the fire. And Fat grows together by cold, in a certain degree as it were (for every thing is not made of every thing) and therefore Fat is not bred in any part. Now that Fatness proceeds from Coldness Galen and other Learned men have determined, so that the Fat, light, and thin Part of the Blood, while in hotter Bodies it turns to Nutriment, in colder it is reserved (and therefore hot and dry Animals are hardly ever fat) and when the Veins send it out of

themselves, it lights upon the Membranes, and grows together.

For 1. Even the Blood, when it is out of the Vessels, does after this manner grow together, by meeting with the cold Air, though its internal Coldness do also help forward the mutation.

2. Aristotle saies, among such things as melt, those that are melted by heat, are congealed by cold, as Oyl.

3. The colder Creatures are the fatter, as Gueldings, Females; also such as lie long hid in the Earth without Exercise: So in the Winter, all Creatures are fatter.

4. Fat is only bred in cold places, as in the Membranes: So we see the Call is fat, by reason of its membranous Substance, also in respect of its place, being far from the hot Bowels, for it Guts, under the Peritonæum, and because of abundance of Veins and Arteries, it

How Fat is bred in the Call?

upon the stored such

And about the Heart?

Fat: so about the Heart Fat is collected, for there is the Pericardium, a cold and thick Membrane; also the wheyish Humor contained therein: below it there is the Mediastinum as a Fan, on either side the

And the Kidneys?

Lungs like Bellows, the Mediastinum &c. So about the the Kidneys Fat is gathered, because they abound with a wheyish Excrement, lie near the Backbone, and are covered by the Guts.

5. A Cover hanging over boyling Water, coagulates the Vapors which arise unto it, and turns them into water by its Coldness. For make the Air round about exceeding hot, and then the Vapors striking against the cover, will not be condensed.

An Opinion that Fat is caused by Heat.

Another Opinion is, that Fat is made by an hot Cause, because the matter thereof is hot, and because Fat easily flames; also because all things are made in the body, by Coction, and Heat. But the answer is clear, from what hath been said before. And we do not mean meer Coldness, the Cause of Crudity, but a weak Heat.

An Opinion that it is made by compactness. Refuted.

Some say that Fat attains its consistency from the compactness of the Membranes, for that which is itself compact makes other things so. I answer. That cold things condense, and Condensation proceeds from Cold, nor can that which is condensed condense, unless it were a first Quality, or should take the assistance of Cold, for otherwise the thinness of the Membrane would make the fat thin. And why does not the density or compactness of the Vessels make the matter contained to be condensed and compact?

2. In like manner they object: By a thick cover though very hot, the Vapor arising from boyling Water, when it meets therewith, is turned into Water, or in a Distillation by an Alembick, the Exhalations arising from the subject matter, meeting with the thick glass are stopped, and by reflection turned into a thickened Substance. But the Answer, is clear from what hath been said: moreover, the Vapors which are raised up by boyling, if they are by the Vessel so shut in, that there is no place to breath out, new Vapors continually arising, that there may not be a Penetration of Bodies, it is necessary, that they reassume their former consistency: But if they find egress, they turn to Water, by reason of the cold Air surrounding the glassie Cover. And therefore it is that, to make the Liquor issue more abundantly, Distillers ever and anon cool the same with cold Water. So when the Air abroad is cold, hot Vapors within do turn to Water upon the glass Windows; which does not happen when the Air is hot abroad.

3. They say, that there are many cold Parts, as the Brain and its coats, &c. which have no Fat about them. I answer, those Parts also are dense. Nor would Nature have Fat in those Parts, for it would be both unprofitable and hurtful: And a moderate Heat is there provided for, by the thickness of the Skin, the Hair and the Skull.

An Opinion that it is caused by Dryness.

It hath nothing which

Fabius Pacius makes the cause to be also Dryness, by reason of the Fibers of Fat. To which is repugnant 1 That Fat is not dry, but moist. 2 The Fibers, as the Blood hath. Touching Anatomical Contradictions of my Fa-

Other late Writers are pleased with a new conceit, that Fat is made, by a peculiar fat-making form, as a bone is made by a bone-making form. Who doubtless are mistaken, because 1 Fat doth not live. 2 It hath no certain Dimension. And 3 The blood turns into the marrow of the bones, without the help of such a form.

The Form of Fat as long as it is in the Vessels, is not congealed, but liquid and melted, by reason of the Heat which as yet remains in the Vessels. It hath been voided liquid by Urin, as *Helypous* hath observed, and in an healthy Woman by *Aool*, in the Observation of *Hildanus*. *Folius* conceives it is liquid in the Vessels, by reason of likeness of Nature, but that it is congealed without, because of the different Nature of the Fibres. But no man can easily observe the dissimilitude of the fibres, either within the body, or without.

The Fat of the Belly hath three Veins, the external Mammillary descending from above the *Vena Epigastrica*, arising from beneath out of the crural Vein, through the Groins, and very many Veins coming out of the Loins, accompanied with Arteries. And through these, and the Vessels of the Skin, Cupping-glasses and Scarifications draw Humors out of the inner Parts, as far as I can conceive.

It hath a very great abundance of *Kernels*, which receive Excrements out of the Body into themselves. In sickly persons, and such as abound with excrementitious Moisture, they are more plentiful.

The Use of Fat is 1 To keep warm like a Garment, to cherish Natural Heat, by its Clammyness, hindring the going forth thereof, and by its thickness, stopping the Passages, least Cold should enter; and in Summer, they keep out the Heat.

2. In a special manner to help the Concoction of the Stomach. And therefore the cutting out of the Gall breeds Winds and Belchings, and to cause good Digestion, it is necessary to provide some other covering for the Stomach.

3. To daub and moisten hot and dry parts, such as is the Heart.

4. To facilitate Motion, provided it be moderate, for abundance of Fat hinders Motion and all other Actions, and to keep the Parts from being over dried, distended, or broken. Hence it defends the ends of Gristles, the Joyntings of the greater Bones; and it is placed on the outside of certain Ligaments, also about the Vessels carried to the Skin. For this very cause, there is store of Fat in the Socker of the Eye, least by reason of continual Motion, it should become dry and withered as it were. And the *Vena Coronalis* of the Heart, is fenced with much Fat, to accommodate the great Motion and Heat of the Heart.

5. It serves as a Pillow and Bulwark against Blows, Bruises, and Compressions. And therefore it is that Nature hath furnished the Buttocks, and the Hollow of the Hands and Feet with plenty of Fat.

6. In times of Famine, it is turned into nourishment, for we are nourished with that which is sweet and fat, as being familiar to us and our Nature, if we will believe *Galen* and other Authors. Whose Intention *Rondeletius* interprets to be, that the Fat doth only relieve famished persons, and hold the parts of the Body in play, till they attain their proper Nourishment.

It fills the empty spaces between the Muscles, Vessels.

By a peculiar Form.

The form of Fat.

Its Vessels.

Its Kernels.

Its Uses.

Whether it may turn to nourishment?

Vessels, and Skin, and consequently renders the Body smooth, white, soft, fair, and beautiful. And therefore persons in a Consumption and decrepit old Women are deformed, for want of Fat.

CHAP. IV.

Of Membranes in General, of the fleshy Membrane, and the Membrane which is proper to the Muscles.

The fleshy Membrane, its situation. **U**nder the fat in a Man, the *Membrana carnosæ*, or fleshy Membrane lies, which in Apes, Dogs, and Sheep lies next the Skin. Before we treat thereof, some things are to be known concerning the Nature of a Membrane in general.

The Ancients called the Membranes *Hymenæ*, and sometimes *Chitonæ*'s Coats, also *Meningæ*; and otherwhiles *Operimenta*, and *Tegumenta* Coverings; and with *Galen* and other Anatomists, speaking in a large Sense, a Coat and a Membrane, are one and the same thing. But when they speak in a strict and proper Sense.

The difference between a membrane and a Coat, and Meninx. That is a Membrane which compasses some bulkie Part, as the Peritonæum, the Pleura, the Periostium, the Pericardium, and the peculiar Membranes of the Muscles.

But the term *Tunica* or Coat in a strict sense, is attributed properly to the Vessels, as Veins, Arteries, Ureters, the Womb, the Gall-bladder, and the Piss-bladder, the Gullet, the Stomach, the Guts, the Stones.

The term *Meninx* is properly given and peculiarly to the Membranes of the Brain.

What a Membrane is? Now a Membrane is a similar part broad, plane, white, and which may be stretched, made by a proper Membrane-making faculty, of clammy and watery Seed, to the end that it might by cloathing defend the Parts.

The Form thereof is the equality of its Surface, Thinness, and Lightness (least it should burden) compactness and strength that it might be widened and stretched.

Its Use. 1. To cloath and defend the Parts by reason of its hardness and compactness; and to be the Instrument of feeling: For the Parts feel by help of the Membranes. And so great is the necessity of Membranes, that Nature hath covered every Part with a Membrane. 2. To strengthen the parts. 3. To defend the parts from the injury of the Cold, and to keep the Natural Heat from exhaling. 4. To joyn parts with parts. So the Mesentery knits the Guts to the Back. 5. To shut the mouths of the Vessels, least the Humors should flow out, or flow back: As in the Bladder, where the Ureters are implanted, in the Ventricles of the Heart, by the Valves.

The Difference of Membranes. Now a Membrane is thicker or thinner. The thin Membrane differs in thinness. For the Periostium of the Ribs

is thinner then the Pleura, the Periostium of the Head, is thinner then the Pericranium; the *pia mater* is thinner then the *dura mater*.

The thick Membrane is the *Membrana carnosæ*, which is not every where alike thick; for it is thicker in the Neck then other places. And now let us speak of the *Membrana carnosæ*, or fleshy Membrane.

The *Panniculus carnosus* or *Membrana carnosæ* is by some termed a membranous Muscle, by others a Nerve Coat, a fatty Coat, &c. It is termed fleshy, because in some places, as about the Forehead, the compass of the Neck, and the Ears, it turns to a musculous flesh, and in such Creatures as by the help hereof can move their whole Skin, it seems to be a Muscle: It is endued with such fleshy Fibers, especially in their Necks, by the motion whereof they drive away flies. But in Man, save in his Forehead, it is immoveable; only *Vesalius* and *Valverda* report that there were some men who could move the Skin on their Chest and Back, and in other parts, just as oxen do. In whom doubtless this Membrane was made of the same constitution, which it hath in Brutes. Moreover in new-born Children, it resembles flesh, by reason of plenty of blood; in grown persons it is like a Membrane, by reason of continually being dried. In a Mans Body, if exact Separation be made, it will appear to consist of four distinct Membranes. *Spigelius* and others do take those membranous Fibers, which are every where interwoven among the Fat, to be *Panniculus carnosus*, or *Membrana carnosæ*.

Its Use is 1. To defend the neighboring Parts, yea, and to cover and defend the whole Body, and therefore it is situate all over the body.

2. To keep in the Fat, that it flow not out, or melt by reason of the continual motion of the Muscles.

3. To support those Vessels which are carried into the Skin (which go between the Skin and this Membrane) for it is knit unto the Skin by very many Veins, some fewer Arteries, branches of Nerves, and membranous Fibers; and to the Membranes under the Muscles, by the smaller Fibers. It is therefore false, that when the Fat is consumed by fasting, the Skin sticks to the Muscles no otherwise, then a Ball to a piece of cloth wherewith it is covered. It sticks most firmly to the Back, in fashion of a Membrane, and therefore it is said to arise from thence. In the former part of a Mans Neck and his Forehead, it can hardly be separated from the Skin and the *Musculus latus*; it sticks so close, and is thought to constitute the *Musculus latus*.

The Surface thereof is slippery, there where it touches the Muscles, by reason of that clammy Humor, which is wont to be daubed upon the Membranes, least the motion of the Muscles should be hindered. It is of exquisite sense; and therefore if it be twitched by a sharp Humor, it causes shivering and shaking, as by Choler in Agues.

The proper Membrane of the Muscles, which some will have to spring from the Pericranium or Periostium, others from the nervous Fibers of the Muscles, is thin, and is knit unto the Muscle, by most thin filaments.

Its Use is 1. To cloath the Muscle and separate them one from another. 2. To impart unto them the Sense of

The fleshy Membrane what for a thing it is?

Its Use.

Connexion.

Original.

The Membrane of the Muscles, what?

Use.

HAP.

CHAP. V. Of the Muscles in General.

A Muscle is termed in Greek *Mus* a Mouse, because it resembles a flaid Mouse; and the Latins call it *Lacertus* a Lizard, from its similitude with that Creature: Howbeit we cannot allot one certain figure to the Muscles, by reason of their variety.

What a Muscle is? A Muscle is an Organical Part, the Instrument of voluntary motion. For only this part can receive the influx of the motive faculty. *Helmont* allows

the muscles a life peculiar to themselves, which continues for a while, even after death, as the convulsive motion in the Falling-sickness which continues involuntarily. Which nevertheless does more truly arise, from the retraction and driness of the Nerves, and defect of Spirits. Also the same man is in an error in conceiving that new fibres do arise in the muscles, and cause the Palsie. No man ever saw them, nor can they be bred anew, because they are Spermatick parts. The Palsie ought rather to be referred to a defect of some fibres.

A Muscle is an Organical part. A muscle is an Organical part, because it consists 1. Of flesh. 2. Of a tendinous part (and these are the two parts of a muscle, which perform the Action) 3. Of Veins to carry back the Nutrient. 4. Of Arteries preserving the inbred Heat, and bringing the Nourishment to the part. 5. Of Nerves, which contribute sense and especially motion. For the Brain sends the motive faculty through the Nerves into the Muscles. 6. Of Membranes which encompass and keep the muscles together. 7. Of Fat which moistens them, and hinders them from being dried by over much motion.

The Connexion of the Muscles of the whole Body.

The Muscles of the whole Body are most straitly joyned one with another: Yet sometimes they gape, and are at some distance, when Wind, wheyish Humor, or some other matter gets between them; as in the bad Pleurisie, and concerning a Soldier whipt by the Turks. *Veslingius* told me that his muscles were so widened and separated, that if he bent his body but a little, every muscle would bear it self out from its Natural situation, bunching out as it were, and swelling.

The Parts of a Muscle only two.

The tendinous Part how many fold.

We divide the Muscles into two parts, a fleshy part, and a tendinous part.

Again, we make the tendinous part to be either united, or disgregated, and severed.

United, where the whole tendinous part appears, white and hard, either in the beginning, end, or middle; or in

all these parts.

Contrariwise it is disgregated or severed, where it is divided into many small fibres, scarce discernable to the sight, being compassed about with flesh; which tendinous fibres may notwithstanding be discerned among the fleshy ones, in boyled Hogs-flesh, and in the flesh of a Turkey-cock, &c. So in some Muscles, especially of the Thighs of a Turkey-cock, the tendinous part appear whole and united from the beginning to the end. So in a man, sometimes the Tendon descends gently after its Original, mixed with

flesh. Sometimes the tendinous part appears, united in the end, and severed in the beginning, as in the muscle *Deltoides*; sometimes it is tendinous in the middle, and sometimes not at all.

With *Aquapendens* we define a Tendon to be a Body continued from the beginning to the end of a Muscle, and that it is a body of a peculiar Nature, cold and dry, made of Seed, as the principle of its Generation: But the beginning of its dispensation is a bone, for it springs from a bone, and is inserted or implanted into a bone. Yet some Muscles arise from Gristles, and some from Tendons, and are implanted into them. And it is rightly termed *Tendo*, from stretching, because it is bent and stretched like the string of a bow.

What the Tendon of a Muscle is? **Its Beginning.** The beginning of its dispensation is a bone, for it springs from a bone, and is inserted or implanted into a bone. Yet some Muscles arise from Gristles, and some from Tendons, and are implanted into them. And it is rightly termed *Tendo*, from stretching, because it is bent and stretched like the string of a bow.

A Muscle is otherwise divided into the Head, middle, and End.

The Beginning and Head of a Muscle. The Beginning when it is tendinous, is by *Galen* and other Anatomists, called *Ligamentum*, which they say is void of Sense, and that it is less than a Tendon, or the end of a Muscle.

Now the beginning in a great part of Muscles, is tendinous, seldom fleshy. And to speak the very truth, the beginning may as well be termed a Tendon, as the end; seeing for the most part, such as is the Beginning, such is the End, in Substance, in Thinness, Lightness, Whiteness, &c.

Now every Muscle is said to move towards its beginning, and every Muscle hath a Nerve, which is inserted either into the Head, or about the middle (and in some through the Surface of the muscle, in others through the Substance) so that where the Nerve is implanted, there is the Head of the Muscle: Which *Galen* laies down as a sure Rule, and saith; that if the Nerve be implanted into the Tail, there is the Head of the muscle. But *Johannes Waleus* an excellent learned Physician, likes not this Rule, and conceives that it is all one, whether the Nerve be inserted into the beginning, the middle, or the end. 1. Because that Rule renders the motions of many muscles obscure. 2. Because it holds not true in the Pectoral muscle, nor sometimes in other muscles of the Chest and Belly. 3. Because that Rule is not founded upon any reason, for whether the Nerve be inserted into the beginning of the muscle, or into any other part thereof, the Spirits flowing in by the Nerve, may equally move the muscle: As we see in Wind-Instruments, the Air is let in sometimes above, sometimes beneath, one way as conveniently as another. 4. And whereas that Rule is oftentimes found true, it happens by accident, because most muscles are moved upward, &c. because the Nerves descend from above, and therefore could not be more safely implanted any where, then in the upper part of the muscles. And that which *Riolanus* objects against *Waleus*, touching the Contortion or Wreathing of the recurrent Nerve, is nothing. For the Nerves run back, to avoid confusion, otherwise, if Nature chiefly intended the Insertion into the Heads of Muscles, the might have

What the Tendon of a Muscle is?

Its Beginning.

Why called Tendo?

The Beginning and Head of a Muscle.

Both the beginning and end of a Muscle may be called a Tendon.

Two things observable touching the beginning of a Muscle.

Galens Rule.

Disliked by Waleus; and why?

The Objection of Riolanus answered.

have carried them right out into the Larynx, as the doth other Nerves of the first Pair. Some Muscles receive two branches of Nerves, as the Midriff: some five, as the temporal Muscle.

The middle of a Muscle. *The Middle of the Muscle*, which they call the belly or body, doth for the most part swell, and is fleshy: some few have a tendon in the middle, as the Musculus Digastricus which opens the nether Jaw, and the second Pair belonging to the Os Hyoides.

The end of a Muscle how known by Galen and other Anatomists? *The end or tail of a Muscle*, is by some called *Tendo*, by others *Chorda*, and *Aponurosis*. And the end is sometimes round, sometimes broad, sometimes long, other whiles short; sometimes one, other whiles more than one. Now this end, or tendon, is commonly conceived to be made up of a Concourse of Fibres, Ligaments, and very small Nerves, which by little and little grow into one Body. For they will have a Nerve, when it comes to the place of a Muscle to be divided into divers slips, which are met by a Ligament, cleft after the same manner. Consequently they Determine.

Whether the Head of a Muscle be void of sense? 1. That the Tendon hath the sense of Feeling, but not the Head, which they account void of sense and Motion. But this is false; because the tendinous head of a Muscle, when it is prickt, breeds Convulsions and cruel Symptomes, just as if the Head of the Muscle were prickt. Moreover, the beginning of a Muscle hath motion, and therefore sense. It hath motion, because a Muscle, even in its Head, is contracted and expanded, especially when it is fleshy.

Whether the end be thicker then the Head. 2. They say also that the End is thicker then the Head: which notwithstanding is sometimes true and sometimes false, as in the Muscous Biceps, and others.

3. They will have the Tendon to be softer then the Ligament (as they call it) or the beginning of the Muscle, namely so much softer, as it is harder then a Nerve. But the contrary is true, viz. that the Tendon is harder then the beginning, because it many times changes into a boney and gristley substance, as in the feet of feathered fowle; but the beginning doth not so. Moreover, I deny that Nerves enter into the Tendon. For *Aquapendens* and *Riolanus* have observed, by frequent dissections, that when they are entred into the flesh of the Muscle, they are spread out into many little branches, which go into a certain Membranous flexure, and so vanish or end, before they come to the tendon. Moreover, a Nerve is soft, how therefore can it be mingled with an hard body? Neither is the end less destitute of sense, then the Head, seeing there come no more Nerves to it then the other: for the Nerve being implanted, tends downwards, and not upwards.

Whether the Nerves go into the Tendon. *The Action of a Muscle* is voluntary Motion. *The Motion of a Muscle*, is threefold, 1. A Muscle is contracted within it self, towards the Head; and when this is done the opposite Muscle is relaxed and loosened. 2. Being contracted, it continues so. And these two motions are primary, *per se* and not accidental. 3. After contraction it is relaxed, which motion

is accidental, and proceeds from another. And therefore Muscles are alwaies set one against another, as Antagonists.

Now the work of this Motion or Action, which is seen in the parts, whereinto the Muscles are planted, doth vary according to the Variety of Parts. For in the throat it is swallowing; in the Arms bending and stretching forth, &c. Yea and sometimes one follows upon another. For the Muscles of the Chest, when they act, do diversly widen or contract the same, they draw in Air, or expel Fuliginous sooty vapors, and cause Respiration.

This Motion of the Muscles, is sometimes called Voluntary, sometimes Animal, to distinguish it from the natural, in Brutes Spontaneous. For we can hasten, or slacken, or stop this motion as we please. And in this motion, the will of a Man or the Appetite of Brutes, is like an Horseman guiding and putting his Horse forward; the Nerves resemble the Reins of the Bridle, and the Muscles are like the Horse. There are some singular Muscles, as of the inside of the Eare, the Midriff, the Muscles of the Chest, and Eye-lids, whose motion is partly voluntary and partly natural, because they many times perform their actions, which we have no thought nor will thereto.

The use of all the Parts of the Muscle, is *The use*, after the same manner, as in every perfect Organ. For 1. There is that by which the action is primarily and of it self performed, and it is the Fibrous flesh; [but especially according to the Fibres, for the flesh being wounded according to the length of the Fibres, the motion remains unhurt, but it is not so, when the fibres are wounded] for the most part the belly of the Muscle, which is most of all contracted. Hence it is that if you cut a Muscle of in the beginning end or middle, in a living person, or in one that is dead it purses it self round and draws it self into it self like a ball: as also it doth, being cast into the water. *Riolanus* counts the principal part to be the tendon, upon which the Action depends, because it hath a peculiar substance of its own, such as is no where to be seen out of a Muscle. But this is rather true of fibrous flesh, which is in all Muscles, where as in some there is no tendon. 2. That without which it cannot be performed as the Nerve: For if the Nerves be hurt the Muscle looses its motion. 3. That by which it is more strongly and better performed, as the tendons and tendinous fibres. Wherefore those Muscles only, which perform continual and strong motions, have received united and Conspicuous tendons. For the Muscles do either move themselves only, as those of the Fundament and Bladder; or they move also the skin, as in the Lips, forehead and face: and in these there is no tendon to be seen: or they move a bone, and these for the most part evidently end in tendons, because the strong motion of an heavy member did require as much: or they move some other light thing, as the Muscles of the tongue and Larynx (some of which have tendons and some not) of the Eyes, Stones and Yard. 4. Such parts as conserve and guard the action, as the Veins and Arteries, the Membranes and fat.

Which Muscles do move more strongly?

CHAP.

CHAP. VI. Of the Muscles of the Belly, or Abdomen.

Those which are called *Musculi Abdominis*, the Belly-muscles, do cover the lower Belly, and *Galen* reckons as many, as there are positions of fibres;

right, transverse, oblique, and these either upwards or downwards. So that according to *Galen* there are eight, four on each side; two oblique descendents, or external oblique ones, two oblique ascendants or internal ones, two right and two transverse: But *Massa* found out two others, and after him *Fallopian*, which they term *Pyramidal Muscles*, others *Fallopian Muscles*, and *Sylvius* calls them *Succenturiatos*. And so hither Anatomists have made these muscles ten in number. *Casseri* accounts the right Muscles to be many, and that rightly; seeing there are for the most part four of them on each side; and so for the most part.

This TABLE represents the Oblique Descendent Muscle of the Belly out of its place, and the rest of the Muscles in their proper places.

The III. TABLE.

The Explication of the FIGURE.

A. Part of the Obliquely Descendent Muscle on the left side.

A. The beginning of the Obliquely Descendent Muscle removed out of its Situation, in the right side, as also the insertion of many Nerves, and the oblique carriage of many fibres.

B. The Right Muscles, of which two are found above the Navil N. and one beneath it.

C. The fleshy part, or Belly of the obliquely descendent Muscle ends here; and here begins the Tendon or Membranous end thereof.

D. The hole in the Tendon of this Muscle, through which the Spermatick Vessels, are sent into the Stones towards the Cod.

E. The obliquely ascendent Muscle, in its situation, with the Fibres which run to the upward parts.

F. The fleshy beginning of the obliquely ascendent Muscles, growing out of the sharpe point of Os Ilii, or the Appendix GG.

G. The Spina, or that same Appendix of the Os Ilium.

H. The Line about which the Tendons of the oblique Muscles of the Belly begin, which *Spigelius* calls *Semilunaris*, the half-moon-shap'd Line.

I. The streight Muscles transperans under the Tendons of the oblique ascendent Muscle.

K. Productions of the Peritonæum, involving the spermatick Vessels, and descending into the Cod.

L. Holes in the end of the Ascendent and Right Muscles, so let the spermatick Vessels through.

M. The Kernels of the Gland laid open.

N. The Navil.

O. The white Line of the Belly.

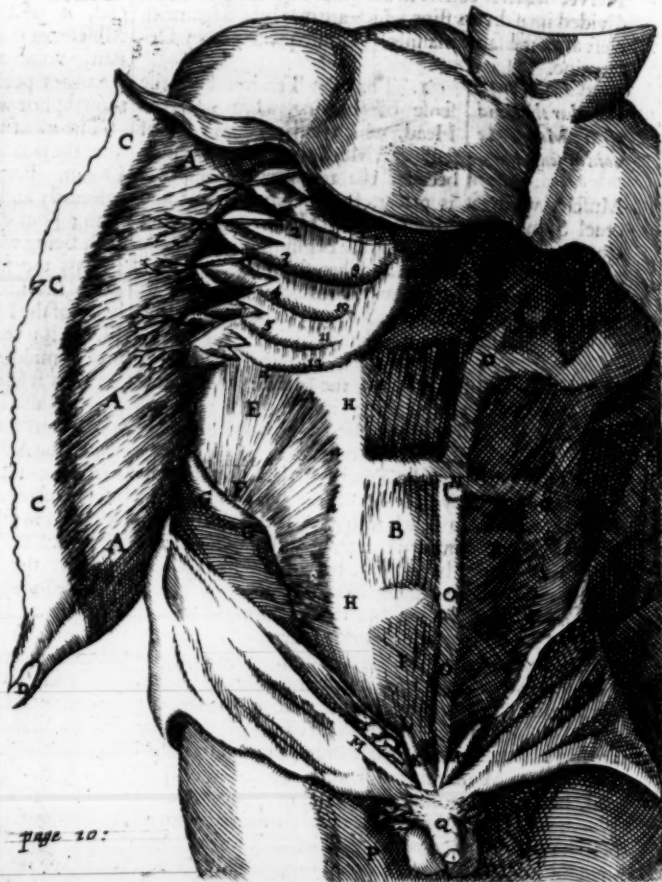
P. The Thighs near the Privities.

Q. The Neck or Yard.

I. 2. 3. 4. Ribs, which proceed from under each Rib, so be distributed into the oblique descendent Muscles.

9. 10. 11. the four lower Ribs.

aaa. The beginning of the oblique ascendent Muscles.

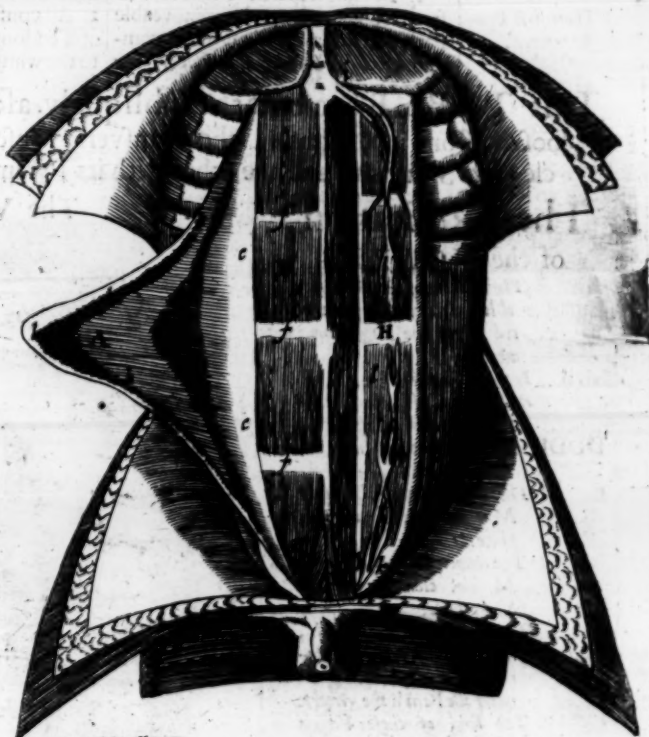


In this TABLE are shown the right Muscles of the Belly, with their Inscriptions, as also the Epigastric and Mammary Vessels, which are conspicuous from their inner side. Also the transverse Muscle of the Belly, separated about its beginning, and the *Pyramidal* Muscles in their Situation.

The Explication of the FIGURE.

The IV. TABLE.

- A. The transversal or overthwart
Muscle, made loose about its
beginning.
- bbb. Its beginning.
- cc. A portion of the Tendon.
- D. The right Muscle.
- e. Its beginning.
- fff. Nervous Inscriptions.
- g. The End.
- H. The back-side of the other right
Muscle, wherein.
- I. Shows the Dug Vein and Artery
descending.
- kk. The Epigastric Vein and Artery
descending.
- ll. The Concourse or Anastomosis
of the Veins.
- MM. The Peritonæum freed from the
Muscles.
- NNN. The Pyramidal Muscles.
- OO. The productions of the Perito-
næum descending into the
Cod.



page. 11.

there are sixteen Muscles of the Belly for the most part, at least and seldom fourteen, when there are only three right Muscles on either side; sometimes eighteen, when there are five right ones found, on each side. Fontanus found them all, folded and wrapped up in an Embryo or imperfect birth.

The first Pair obliquely descendent, [or the external] so called by reason of the Fibres, which descend obliquely from the upper to the lower part; covers all the *Abdomen*, on its own side, seeing it is very great and broad.

Its original is in the breast, from the lower part of the sixth, seventh and eighth Ribs, before they end in Gristles; and it arises from sundry triangular beginnings, or spires, [near the great saw-shap'd Muscle of the Breast] which afterwards grow into one. And to every triangular spire, from the spaces between its Ribs, and Nerve is carried. Moreover, it arises also [a final space being interposed] from the point of the transverse processes of the Vertebra's of the Loyns. So largely is the beginning thereof spread out, namely from the sixth Rib to the lowest Vertebra of the Loyns.

It ends in the middle of the Abdomen, where a white line appears, and it ends into a large Tendon, an infinite company of ob-

lique Fibres running together in that place.

Now the *white Line*, which is sometimes fringed with fat, is the meeting together of the Tendons of the Muscles of the Belly, saving those of the right muscles. For the Tendons of the oblique muscles are united. and do so meet form both parts, that they form as it were a coat which covers the Belly, or as if it were but one Tendon.

It is white, because void of flesh, proceeding from the *Mucronata Cartilago* or pointed Gristle which is seated at the Sharebone: and it is narrower below the Navil then above.

The two muscles obliquely descendent are bored through. 1. At the Navil. 2. At the Groyn in men, that the seed Vessels may pass through; in Women, to give passage to the two round and Nerry Ligaments of the Womb, which are terminated in the Privy near the *Nymphæ*.

What the
white Line
is?

The Error of Aquapendent and Laurentius, touching the Original of the oblique-descending Muscle.

Now as touching the Original of the obliquely-descending muscle, *Aquapendent* did long since hatch a contrary Opinion, which *Laurentius* did afterwards propound as new, and of his own Invention, reprehending all other

Anatomists, who were the said miserably deceived. Now this contrary Opinion will have these muscles to be rather termed external Ascendents, so that their Original should be from the upper part of the *Os pubis*, *Os Ilij*, and from the transverse Processes of the Loins: And the end, in the Ribs. They prove it thus:

Their first Reason refuted.

1. Because a muscle ought to arise from some quiet and immoveable part, such as is the Share-bone compared to the Ribs. I answer, the

Ribs are quiet and still, being compared to the white Line.

2. They say a muscle draws towards its beginning, and because the oblique-descendent serves for Respiration, it draws the Ribs towards the Share. I answer, this muscle doth not primarily serve for Respiration, as I shall shew hereafter.

Now our Opinion, which is *Galens*, is proved. 1. By the Ingress of Nerves, which is about the beginning. 2. By the carriage of Fibres, which go here from the beginning to the white Line. 3. All confess that there is a Concourse of Tendons, yea of those which obliquely descend, into the white Line. Therefore the End is there. 4. It

Their second Reason

answered.

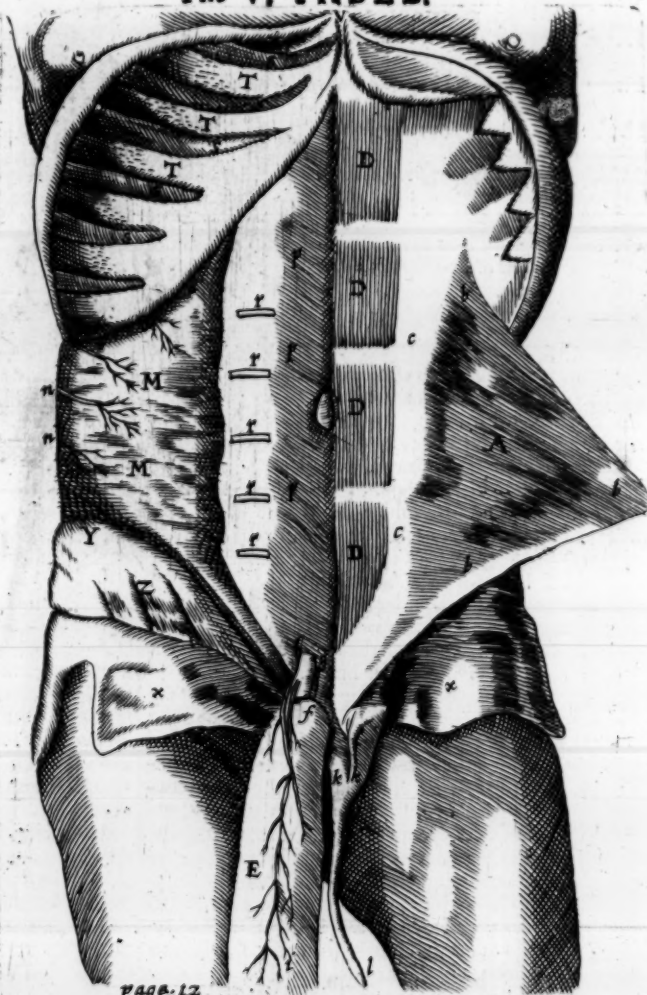
Tis proved that these Muscles arise from above, not from beneath.

This TABLE presents the Obliquely-ascendent Muscle of the Belly, loosned from its Originals; the Transverse Muscle, and the one straight Muscle in its Situation, and the other with its Pyramidals removed from its place.

The Explication of the FIGURE.

- A The Muscle of the Abdomen obliquely ascending separated about the beginning; wherein.
- bbb. Is the Beginning.
- cc. A Portion of that tendon which covers the right Muscle.
- DDDD. The right Muscle in its Situation.
- E. The inner side of the right Muscles drawn out of its place.
- f. The lower End of the right Muscle, cleaving to the Share-bone.
- gh. The Epigastrick Vessels, which spring from the Ramus Iliacus, of which g denotes the Vein h the Artery.
- i. The End of these Vessels which are joyned with the Mammaria Descending from above.
- KK. The Pyramidal Muscles removed from their place.
- l. The Tendon of these Muscles which reaches to the Navil.
- MM. The transverse Muscle.
- nn. Its first Original which is Nervous & membranous.
- ooo. Its second fleshy Beginning.
- ppp. Its Tendon which grows to the Peritoneum.
- qqq. The Nerves which come from the marrow of the Back to this Muscle.
- rrrr. The Boughs of the Vein and Artery of the right Muscles, which are sent unto the transverse Muscle cut off.
- SSSS. The Ribs.
- TTT The Intercoastal Muscles.
- V. The Os Sternum or Breast-bone.
- XX. T Skin separated and hanging down.
- Y. The Spine, or sharp point of Os Ilij.
- Z. Certain Muscles which grow to the Os Ilij.

The V. TABLE.



is proved by the common Action, of which beneath.

The Use [according to *Riolanus*, who saith that the *Os pubis* or Share-bone being moveable, doth move this boney structure forwards, the Chest resting, or being lightly moved, in the Conjugal Embrace, and in the going of such as want Legs and Thighs. But we daily observe the Belly to be moved, in single persons that are chaste, nor doth Nature frame Parts to supply unexpected defects of muscles, but for Natural and Ordinary Actions. *Spigelius* suspects, that from the same moveable beginning, that same bone is drawn obliquely upward, and enclined toward the Chest, by the help of the muscles.

The second pare is the OBLIQUELY ASCENDENT [or internal] having Fibres contrarily situated : It is situated next the former, and hath a triangular Figure.

The Original of the obliquely ascendent Muscles. Its Original is fleshy, from the Rib of *Os Ilii* : but membranous, both from the transverse Processes of the Vertebra's of the Loins, from which it receives Nerves, and from the sharp points of *Os sacrum*.

Their double End. It grows a little by a fleshy End, to each of the bastard Ribs, and to some of the true Ribs, but the rest its End turns by little and little into a Tendon, which is double : The one part goes upon the right muscles, the other beneath, so that the right doth rest as it were in a sheath, but near the white Line it is reunited, and inserted thereinto. Which *Riolanus* hath observed to happen only above the Navil, and not beneath.

The third pare of the right Muscles, by reason of the right fibres. This pare is commonly reckoned to be but one.

The Original of the right Muscles. *Galen* doth rightly make the beginning to be fleshy, arising from the Breast-bone, on each side of the Sword-fashion'd Gristle, and from the Gristles of the four bastard Ribs.

It ends in a Tendon at the *Os Pubis*. Others contrariwise, will have the beginning to be here in the Share-bone, and the End above. But I answer. 1. That the right Muscles receive their Nerves in the upper part, viz. one branch of those Nerves, which were inserted into the oblique descending Muscle, and others also from the last of the Back, and from the first pare of the Loins. 2. A Muscle uses not to have a tendinous beginning, and a fleshy End. Other late Anatomists will have the right Muscles to have two beginnings and two ends ; one beginning and one end in the Breast, and another in the Share-bones. Who are for this Conceit of theirs, beholden to that new opinion touching the moveableness of the Share-bone, of which I shall speak hereafter.

That there are divers right Muscles. The *Musculus rectus* or straight muscle, hath for the most part three. Inscriptions in Persons of a middle stature, and sometimes four in tall people, whose Belly is long. But according to *Carpus* and *Casserius*, we say that suitable to the multitude of Inscriptions, there are more muscles, because 1. To every Joynting there comes a Nerve. 2. If it were but one, being contracted into it self, it could not equally compress all parts. 3. There should be no such muscle in the whole body, wherein nevertheless there are many long ones, without such a number of Inscriptions.

In the internal Surface of the right muscles, there are two Veins conjoynded, with as many Arteries.

The Vein. The upper called *Mammaria*, arise from the *Vena cava*, lying beneath the Claves, the more remarked branch

whereof reaches unto the Duggs, and runs out under the right Muscle, as far as to the Region of the Navil, where it is terminated.

This is met by the other termed *Epigastrica*, which in Women springs from the Womb, in men the *Vena cava* goes upwards towards the upper Vein, which before it touches, it is for the most part obliterated. Yet these two Veins are sometimes joyned together by manifest Anastomosis, touching one another, at their ends. Hence the Consent is supposed to arise between the Duggs and the Womb, the Belly, and the Nostrils. For when the Nose bleeds, we fix Cupping-glasses to the belly, and the Duggs of Women being handled, it incites them to Venery.

The Musculi recti receive Arteries from the Epigastrica Artery, and Nerves which proceed from the last Vertebra's of the Chest. *The Arteries and Nerves.*

The proper use of these Muscles according to *Riolanus*, is to move the Share-bone forward in Generation, which hath been already confuted. *Spigelius* will have them to draw the Breast to the *Os pubis* or share-bones, and the Share-bones to the Breast, in a straight motion, and so to bend the Chest : whence it is, that in Dogs and Apes, they reach as far as to the Jugulum, because their Chest did require very much bowing. But these contrary motions, unless they be holpen, with those incisions of the right muscles, do involve a difficulty. *Helmont* suspects that they are stretched in going up hill, and that from thence shortness of breath proceeds. *Flud* saith, that by a general use, they make the Belly round, and compress it centrally, or towards the middle point thereof.

The fourth pare called the Pyramidal Muscles, do rest upon the lower Tendons of the *Musculi recti*. Nor are they parts of the right Muscles, as *Vesalius* and *Columbus* think ; but distinct muscles, as *Fallopins* proves with reasons, which are partly convincing, partly vain. But that they are peculiar muscles is hence apparent. 1. Because they are cloathed with a peculiar membrane. 2. Their Fibres are different from those of the *Musculi recti*.

Their Use. They rise with a fleshy beginning, not very broad, from the external Share-bone, where also the Nerves do enter : and the farther they go upwards, the narrower they grow, till they terminate with a sharp point, into the Tendon of the transverse Muscle. And from this place I have observed more then once, a small and round Tendon produced, as far as to the Navil.

Riolanus hath observed the left Pyramidal Muscle to be lesser then the right, and when there is but one, it is oftner left then right.

The Use of the Pyramidal Muscles, is to assist the right muscles, in compressing the Parts beneath. Hereupon according as the Tendons of the right muscles are more or less strong, so, sometimes the Pyramidal muscles are wanting (though rarely) sometimes they are strong, otherwhiles weak, and sometimes there is but one. *Baubine* saith : If they are absent, then either the flesh joyned to the Heads of the right ones [which I have often observed] or the Fat performs their Office. And others will have them to be as it were certain Coverings of the right muscles.

Fallopins will have the Pyramidal to compress and squeeze the Bladder, when the Urine is forced out. *Contra* *Aquapendent* will have it, that they raise and lift themselves up, and together with them the Abdomen and Peritonaeum.

næum, that the parts beneath them, may not be too much burthened. Now *Columbus* charges *Fallopian*, that he would have these muscles serve to erect the Yard, whereas that is *Massa* his Opinion [whose Opinion is followed by *Flud*, because of the situation of these Muscles] but they cannot serve for that intent, because they reach not the foresaid part, and because they are found likewise in Women.

The transverse Muscles. The fifth pare called the Transverse Muscles, being lowest in situation, do arise from a certain Ligament which springs out of the *Os sacrum*, and covers the *Musculus sacrolumbus*, also from the lowest Rib, and the *Os Ilij*. They end by a membranous Tendon, into the white Line, and do stick extream fast to the Peritonæum, every where save about the Share. The proper Use of these Muscles, is to compress the Gut Colon.

The Action of the muscles of the Belly. The Action of all the Muscles of the Belly, is as it were twofold. 1. An equable Retention and Compression of the Parts in the Belly: For they all act together, the Midriff assisting them, and this is the reason why the Fibres of all the Muscles, do meet together in one and the same Cord, as they are thus described by *Robert Ellis*.

Why there are divers muscles of the Belly? 2. The Second Action, is upon the former, viz. the guidance of Excrements. And because the number of parts to be compressed is great, as the Guts, Womb, Bladder; one Muscle could not suffice, but there was need of divers, acting in divers places, according to divers Angles: Right, transverse, oblique. Every part indeed hath an expulsive Power; but those parts which are hollow, and often, and much burthened, do need the help of these muscles; as in the Expulsion of Excrements, of Worms, of Urin, of a Child, of a Mole, &c.

A Secondary action of the muscles of the Belly. These are their true Actions, which are apparent from their Fabrick. But Nature sometimes abuses the muscles, to move the Chest, when there is need of a great and violent Expiration, as in Coughs, Coughs, and the like. For then they do not a little compress the Chest.

Their Use. They are of an hot and moist Temperament, because flesh is prevalent in them: And therefore they cherish Heat and Concoction: They are moderately thick; and therefore they defend the Parts, and are a Safeguard to them, even when they rest: Also they conduce to the Comeliness of the Body: And therefore extream Fat, dropied Persons, such as are very lean, &c. are deformed.

CHAP. VII.

Touching the Peritonæum.

Peritonæum, how so called? All the Muscles of the Abdomen being removed, the Peritonæum comes in sight, being spread over the Guts, and having its Name a circumtendendo, from stretching about, because it is drawn over all the parts, which are between the Midriff and the Thighs.

What it is? Now the Peritonæum is a membrane which doth cloath the Bowels of the lower Belly.

It is a membrane, and that sufficiently thin and soft, that it may not be burthenfom; but strong and compact, that it may be loosened and distended. It is thicker in Women, from the Navil to the Share, that it may stretch the more, when they are with Child; in men that are great Feeders especially, it is thicker from the *Mucronata Cartilago*, to the Navil, *Laurentius* conceives for the Stomachs sake, which notwithstanding is hardly probable: for it was fit the lower part should be thicker, least while we stand, it should become slackned and loosened by the weight of the Bowels.

Some will have the Peritonæum to be made of a ligamentous and nervous Substance; others of Nerves only; others only of Ligaments; others of the Coats of the Brain.

The Shape of the Peritonæum is oval: For it is like a Bladder, or a long-fashioned Egg. For it compasses all the lower Belly, and therefore it is answerable

The Shape of the Peritonæum.

accanto in Longitude and Latitude.

Its Surface is inwardly smooth, and as it were daubed with moisture, by reason of the Guts which it toucheth; without it is fibrous, and a little rough, that it may be fastned with the muscles.

Its Surface.

Its Original is at the Back-bone, at the first and third Vertebraes of the Loins, where the Peritonæum is thicker; so that it cannot in that place be separated without breaking.

Original.

It is knit also above most closely to the Diaphragma (and therefore when it is inflamed, the Hypochondria are drawn upwards) beneath to the Share-bone and the *Os Ilij*; before, to the white Line and the Tendons of the transverse muscles.

Connexion.

Now it is in all places double (and *Laurentius* with *Cabrolus* make all Membranes double, even the pia Mater it self) which notwithstanding is most apparent upon the Back-bone, above the Navil it sticks so close, that its doubleness cannot be discerned: But from the Navil to the Share, it is manifestly divided into two Coats, so distant, that in their capacious doubling the Bladder is contained, which hath been observed by few: And that was so ordered. 1. That the membrane might be stronger there, where it is burthened. 2. That the umbelical Vessels, which run out there, may be carried more safely: For they pass through the Doublings of the Peritonæum. Therefore also.

It is double.

The Peritonæum is boared through before in a Child which is in the Womb: Also above it hath holes, where it grows to the Diaphragma, for the passage of the Vessels. *Fernelius* hath therefore done ill to contradict *Galen*, in denying that the Peritonæum hath Holes. They are three; The first where *Vena cava* passes through; The second where the Stomach passes; The third where the great Artery and the Sixth pare of the Nerves do pass through the Midriff. Beneath about the Fundament, the Neck of the Bladder and Womb, and the Vessels which pass through the Peritonæum to the Thighs, the Muscles of the Abdomen and the Skin.

The Error of Fernelius.

How many Holes there are?

It hath two oblong Procceses or Productions, like Pipes and wide Channels, descending in men, into the Cod, by the Holes of the Tendons of the oblique and transverse muscles, in which productions (call'd by the Ancients *Didymi*) the Seminary Vessels descend and run back, and near the Stone. These productions are more widened and become the Coats of the Testicles.

Its Productions.

Where

The Cause of a Rupture. Whereof, if the outer Coat be widened, and the inner (which sticks most exactly, save by the Share-bone, where it is separated) broken, a Rupture is made, according as the Gut or Call, or both, slip down.

Its Vessels. It receives *Vessels* from the neighboring Diaphragmatick, Mammary, and Epigastrick Vessels, and sometimes from the Seminary. It receives small *Nerves*, from those which are carried to the muscles of the Abdomen. And therefore the Peritonæum hath the Sense of Feeling,

contrary to what others have thought before *Vesalius*, against whom Experience also bears witness.

The Use of the Peritonæum, is the same with that of membranes in general. 1. To contain the parts, and to lend *Counexions* here and there. This the Peritonæum doth most of all: for it covers all the Bowels of the lower Belly, and makes them more firm; lengthens out, and bestows a Coat upon all of them, to some a thinner, as need requires, and to others a thicker, as to the Stomach, Guts, Bladder, and

It is the mother of the Coats in the lower Belly.

The Peritonæum is here expressed, with its procceses, under which the most of the Bowels of the Lower Belly discover themselves,

The Explication of the FIGURE,

The VI. TABLE

- AAAA. The four common coverings of the Body dissected Crosswise.
- BBBB. The Muscles of the Belly dissected after the same manner.
- CC. The Breast-bone or Sternum.
- D. The sword-shap'd Gristle.
- EEEE. The Peritonæum covering the whole Cavity of the Lower Belly and going about the same, under which the Bowels seem to shew themselves.
- FF. The liver appearing through the Peritonæum.
- a. A cleft into which the Navil vein L. is inserted.
- GG. An obscure appearance of the stomach.
- H. The figure of the Spleen appearing situate in the left Hypochondrium.
- IIII. The manifold turnings and windings of the Guts, which appear obscurely in this place.
- K. The Navil.
- L. The Navil vein freed from the covering of the Peritonæum.
- MM. The two Navil Arteries.
- N. The Urachus or Piss-pipe.
- OO. Vessels distributed, partly to the bottom of the stomach, partly to the Call.
- PP. Productions of the Peritonæum, wherein the preparatory Vessels are contained.
- QQ. The Muscles of the stones called Cremasteres or suspensores, of which the right is seen in its own place well near, but the left hangs separated.
- RR. The stones freed from the Cod.
- S. The Share Bone.
- T. The Prick or Yard.
- V. The Rise of the Epigastrick Vein.
- X. The Epigastrick Artery, being a companion to the Vein.
- Y. A certain branch of the Epigastrick Vein.
- Z.



page 15

Womb

Womb. Also from it proceed two doubled members, the Call and the Mesentery. This also is an Office of the Peritonæum, that Vessels which are to be carried a great way, do run along between the two Coats thereof.

2. To shut the Orifices of the Veins. Hence the Liver, if it were not covered with a membrane, the mouths of its Veins would come into view. Hence also those parts in which there are more Arteries, have received a thicker Membrane, as the Spleen. 3. To further the actions of the Muscles of the Belly; out of

Galen

Chap. VIII. Of the Call.

The Etymologie of the Call.

Under the Peritonæum is the Call as it were a Covering, others name it *Zybus*, *Rete* or *Reticulum*, by reason of the stragling course of the Vessels; the Greeks term it *Epiploon* the Top-swimmer, because it floates and swims as it were upon the Guts. For in all Living-Creatures it is.

It is situate at the Liver, Spleen, and Bottom of the Stomach, and from thence spread upon the Guts, whose turnings it involves and enters into. In some it ceases at the Navil, in others it reaches below the Navil, and sometimes to the Os

Pubis where it is inserted: [Sometimes it is joyned to the Womb with a strait

Connexion, as the rarely learned *Marcus Aurelius Severinus* found at *Naples* in a Shee-Fool; and in another it was kniit to the bottom of the Womb, in *Venice* when I was there] and when it comes between the bottome of the Bladder and of the Womb,

the mouth of the Womb is thought to be compressed, and Women thereby made barren. In men an *Epiplocele* is caused, when it descends into the Cod. And

because it is extended rather into the left then the right side, therefore an *Epiplocele* of the left side is more frequent. *Epiplocele* is a Rupture in which the Call falls into the Cod.

Many times the Guts being left naked, the Call lies lurking under the Liver, which happens not from strangulation.

This TABLE exprestes to the Life the Situation of the Guts and Call and the Navil Vessels.

The Explication of the FIGURE.

- AA. The coverings of the Belly dissected and turned up every way, that the inner parts may come into view.
- B. The Cartilago Mucronata, or Sword-like Gristle.
- CC. The bunching side of the Liver.
- DD. The stomach.
- EE. Part of the Gut Colon fastned under the Liver.
- FFFF. The upper Membrane of the Call, fastned to the bottom of the stomach.
- G. The Navil.
- HH. The Navil-Vein.
- II. The two Navil-Arteries.
- K. The Urachus or Piss-pipe.
- L. The Bladder.
- aaa. The Gastrepiplœic or Belly-Call Vessels, sprinkled through the Call and stomach.
- MM. The Guts.

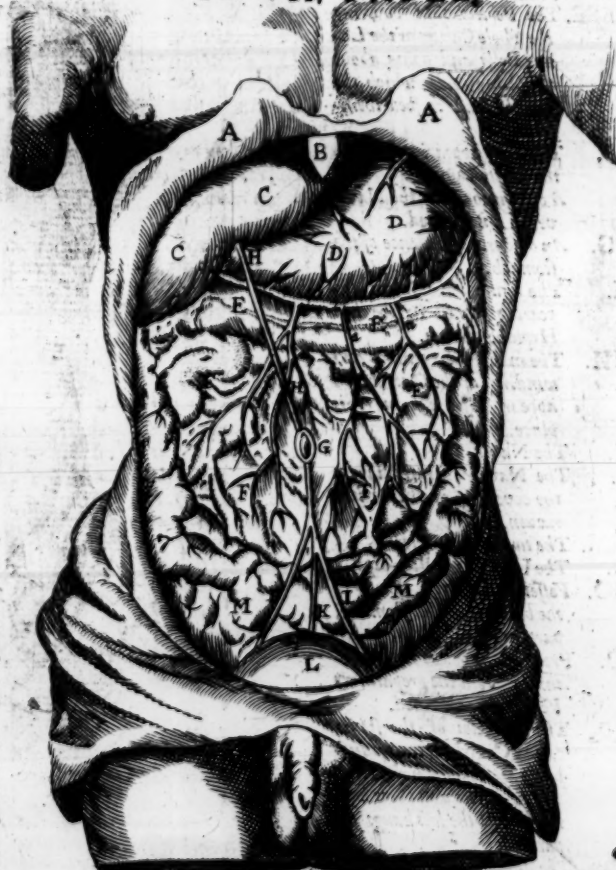
tion, seeing in frangled persons, tis found in its right place, and in persons not frangled, we find it drawn back; but if we may credit *Spigelius*, it comes from the Guts being puffed up with wind. In Hydriopical persons I have found it quite putrified: C. *Stephanus* unjustly denies it to hunters.

In Infants, If we believe *Riolanus* are destitute of a Call over their Guts, which as they grow is spread out downwards, and in declining it is again diminished.

Its Originals from the Peritonæum

- 1. It arises at the stomach, viz. the bottome thereof.
- 2. At the Back and Gut Colon; and no beginning

The VII. TABLE.



cleaves to another. Hence it hath two Walls or two Membranes, thin and light (that they may not be troublesome with their weight) which

which lie one upon another : the external or *former*, which is tied to the outer membrane of the stomach at the bottom, and to the bunching part of the Spleen. The inner and latter, which is tied to the Gut Colon, and arises from the Peritonæum, under the Midriff, just at the Back. And between these Walls, it hath a remarkable Cavity : in which some very foolishly

conceive the Natural spirit is contained. *Riolanus* will have it propagated from a production of the Mesentery, because if you separate the Membranes of the Mesentery, you may proceed as far, as the Gut Colon ; which he proves in another place, out of *Hippocrates*. But in vain, seeing the Mesentery it self, springs from the Peritonæum, and he confesses the fourth part only of the Call to be Mesenterical.

The Figure thereof resembles that of a *Falconders* pouch, for the upper Orifice thereof is Orbicular, and the lower part

of the Call is round after a sort, and sometimes unequal.

The magnitude thereof varies : for it passes in some men to the Navil, in others it goes further, as was said before. Naturally it hardly exceeds the weight of half a pound, *Riolanus* observes. Howbeit *Vesalius* saw a Call of five pounds weight.

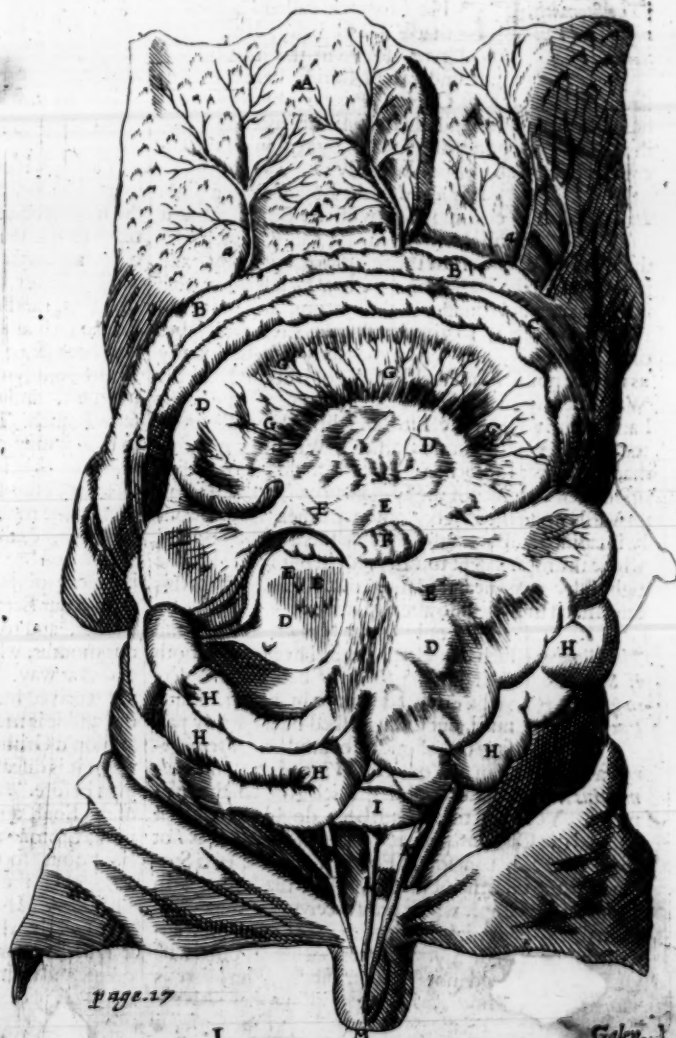
The Call hath this property above other membranes, that through the substance thereof, very many *Veins* and *Arteries* are sprinkled, from the Cæliacal and Mesenterical branches ; and final *Nerves* from a double branch of the sixth Pair. And by reason of the many *Veins*, there is much *Fat* in the Call : and between the same innumerable *Kernels* are interposed, which suck in and feed upon the dreggy humors. Which *Fat* I have often observed to have been molten in such as have been sick of Consumptive Feavers.

This Demonstrates the Lower Membrane of the Call. Also the Mesentery with the Guts and Kernels adjoynd thereto.

The Explication of the FIGURE,

The VIII. TABLE.

- AAA. The lower Membrane of the Call, on which the Colon is suspended.
 aaa. The Vessels of the Call.
 CC. The Ligament of the Gut Colon.
 DDDD. The Mesentery.
 EEE. The smaller Kernels of the Mesentery.
 F. The greatest Kernel of the Mesentery, situate in the middle thereof, called, by *Alellius*, Pancreas.
 GGG. The Vessels of the Mesentery.
 HH. The thin and thick Guts.
 I. The bottom of the Piss-bladder.
 KK. The Umbilical Navil-Arteries.
 L. The Piss-pipe, or Ureachus.
 M. The Navil cut off.



Tis a most rare Case to find the Call perfectly fleshy such as I saw cut out of a Body in the Hospital at *Zeyden*.

The Use, I. By reason of the plenty of its *Fat* it helps and cherishes the heat of the stomach, namely of the bottom thereof ; for the upper part of the stomach is cherished by the Liver, resting upon it ; also it cherishes the heat of the Guts, as being membranous and blood-less parts. And therefore, that same Fencer whose Call was taken away by

Galen, was easily hurt by cold, and therefore he alwaies covered his Belly with Wool. The Call therefore is as it were a Pillow to the Stomach, and furthers Digestion. For that is a rare case which *Forestus* relates of a young man, and *Riolanus* of others who lived well enough, after their Calls were taken away: Peradventure their Stomachs were some other way strengthened, or might be Naturally more strong then ordinary. Otherwise ordinarily, by defect of the Call, Catarrhs, Loosnesses, Lienteries, Consumptions do arise.

2. The Membranes afford this Use, that they prop up the Branches of a Vein and an Artery, which go unto the Stomach, Duodenum, and Colon Guts so called, and to the Spleen; also the Fat grows by benefit of the Membranes.

3. *Walaus* supposes that Branches of Arteries and Veins are attributed in greater quantity unto the Call, then is requisite to breed Fat, and nourish the Call, and that they are there placed, being Branches of *Vena porta*, that the greater quantity of Blood might return to the Heart.

Chap. IX. Of the Stomach.

The Stomach, why called Ventriculus?

The Stomach called *Ventriculus*, that is a little Belly, is an Organical part seated in the lower Belly, just under the Midriff, being the Instrument that makes Chyle. *Parvus* observes that it hath through a Wound in the Midriff ascended into the Chest, and gone downwards by reason of the encrease of the Call. But Naturally;

Its Situation.

It is seated in the Epigastrium, a place encompassed with no Bones, that it might stretch more easily, just under the Midriff, as it were in the middle of the Body, and it rests upon the Back-bone: Now its left side which is the greater and rounder in the bottom, lies in the left Hypochondrium, to give way to the Liver which lies on the right side, and that so the Body may be equally as it were poised, and ballanced; or trimmed, as the Watermen speak of their boats: Towards the right hand it grows small by little and little, that the meat may be gradually thrust thither. Whence we gather that it is better for such as lie down to sleep, to lie first upon their left side till the Digestion be finished, and afterwards upon their right, otherwise then is commonly imagined. But in the left side there is the bottom, where the meat ought to tarry, for being rowled to the right side, it is nearer passing out. Howbeit in this case, much must be allowed to Custom.

The Number of Stomachs in feathered Fowls.

'Tis only one in Number in man, and such live Creatures as have teeth in both their Jaws. *Riolanus* hath twice observed a double Stomach in a man, continued, but distinguished by a narrow passage out of one into another. *Sperlingerus* saw the same in a Woman of *Wittenberg*; and *Helmontius* saw a bag full of stones which grew to the Stomach: Yea, and that it hath been double in one that chewed the Cud, as *Salmuth* relates and others, is not to be doubted. In some Fowls there are two Stomachs, the one membranous, which the Latins term *Ingluvies* the Crop, which only receives the meat, that from thence being lightly digested, they may cast it into the mouths of their young ones, whereas otherwise young Birds could not be nourished. The other is very fleshy and hotter, having within a hard Membrane, wherein hard meat is received. *Petrus Castallus*

a rare man, adds a third, which is in like manner fleshy.

In Beasts that chew the Cud, and have Hornes, and teeth only in one Jaw, there are four; The first *Venter*, the *Reticulum*, the *Omasus*, and the *Abomasus*;

In Beasts that chew the Cud.

of which *Aristotle* speaks. The *Venter* and the *Reticulum* which is a part thereof, are ordained to hold the crude meat; The *Omasus* receives the Food immediately from the mouth, if it be thin, if thick, it is first chewed, and from hence after a short stay, it slips into the *Abomasus*. Now chewing the Cud, is a second chewing of the meat in the mouth, for the more perfect Digestion thereof, whence the Aliment proves excellent, and for that cause among the Jews, such as chewed the Cud were counted clean Beasts. Chewing the Cud is caused, not as some think, because the meat in the first Stomach gains such a quality, that it provokes the Stomach to cast it up; for so in every sharp biting of the Stomach, and in all Animals chewing the Cud, would happen against their Wills: but it depends upon the voluntary Action of the Stomach, which by a singular membrane, expels what it pleases, and when it pleases; as that some Tossot of *Malta*, whom I have seen, would as he pleased cast up what ever he had drunk; and others will swallow down the Smoke of Tobacco, and turn it out again. In great Sea-fishes I have observed a threefold Stomach, as in a Porpice and others; but it grew together, that there was rather three distinct Cavities with passages from one to another, three perfect Stomachs.

It hath two Orifices, and both of them in the upper Region of the stomach.

Its Orifices. The Symptoms of the Stomachs, Mouth, and why like Heart-passions?

The left is commonly called the upper Orifice, and sometimes singly the mouth of the Stomach, and sometimes tis termed the Stomach, because of its largeness; the Ancients did call it

Cor the Heart, because the Diseases thereof caused fainting Fits. and other Symptoms like those which happen to such as are troubled with Passions of the Heart; also because of its most exquisite sense, and because the Heart doth sympathize therewith, both in regard of its nearness, and they have Nerves proceeding from the same Branch. This Orifice is greater, thicker, and larger, so that it may admit hard or half chewed meat. 'Tis situate at the eleventh Vertebra of the Chest: It hath circular fleshy Fibres, that it may by Natural Instinct shut up the mouth of the Stomach, after the meat is received in, least fumes should arise, and go into the Brain, and breed Diseases; and that so Digestion may be more perfectly accomplished. So we cover it as we do our Seething-pots with a potlid, to keep in the Fumes, and to hinder the meat from falling back into our mouths, when we lie in bed, and tumble this way and that way. Through this Orifice, meats and drinks are received in. And it is but in the Epigastrick Region, and it is more near the Back-bone, then the sword-fashion'd Gristle or *Cartilago Ensiformis*: And therefore when it is diseased, we apply Epithems rather behind then before. *Helmont* places the seat of the Soul, and the Principle of life in the Stomach, as it were in its central point, so that it govermes and rules over the Head and principal Faculties. If you aske him more particularly where it is placed, he will answer you that it is there after an exorbitant manner, centrally in a point, and as it were in the middle of an Atome of the thickness of one Membrane. But the Stomach cannot be the

Whether the Soul be seated in the Orifice of the stomach?

the Seat of the Soul, because. 1. It is alwaies full of impure meats. 2. No Faculties flow to us from thence. 3. Great Feeders and persons of large Appetite, should have more Soul then other people. 4. The Soul is not fixed to any Centre. 5. When the Stomach is hurt, death doth not presently follow, as appears in him that swallowed the knife. And any damage happen, it is by reason of the Nearness of the Heart, and Community of Nerves, and consequently by accident. For the Soul sticks not in the Nerves primarily; but there rather from whence the Nerves have their Original; and it is a common Membrane. Yet in a large sense, it may be called the Principle of Life, because there is the Seat of Appetite, and the first Reception and Digestion of Aliments, whose fault in the following Concoctions, is never amended. Now it rules over the Head, by reason of the Consent of the Membranes, and the most undoubted arising of Vapors.

The right Orifice, called Pylorus.

The right Orifice, commonly called the lower, is as far from the bottom, well near, as the left: It is narrower, and abides shut until the Digestion of the meat be finished, that is to say un-

til the meat be turned into a liquid Cream, or Posset as it were. Howbeit *Waleus* hath observed, that it may and doth let out the more liquid meats, and such as are of easie Digestion, by peicemeal before the rest, which may easily be done by opening it self a little way, so that the thicker and undigested meats cannot pass through, as *Riolanus* objects, seeing they cannot pass through a narrow chink: This *Waleus* I say observed in his Dissertation of Living Creatures. *Helmont* affirms that in Vomiting, it is shut upwards towards the Pylorus, because it is inconvenient to Health, that the faculent matter of Vomits should pass downwards. Yet he grants that it is sometimes opened between the first and other Vomits, when somewhat ascends out of the Guts. And the truth is, that it is also open to noxious Humors, *Lienteries* doth witness, and other fluxes of the Belly, *Miserere mei*, and other Diseases, which pass and repass through the Pylorus. The same Person beleives that it remains shut after Death, which doth, I couceive no otherwise happen, then as other parts are then stiff with Cold. It is a lit-

It is opened in the Distribution of Chylus.

It is shut sometimes, and opened in Vomiting.

The Stomach-Nerves so called are Expressed, The IX. TABLE.

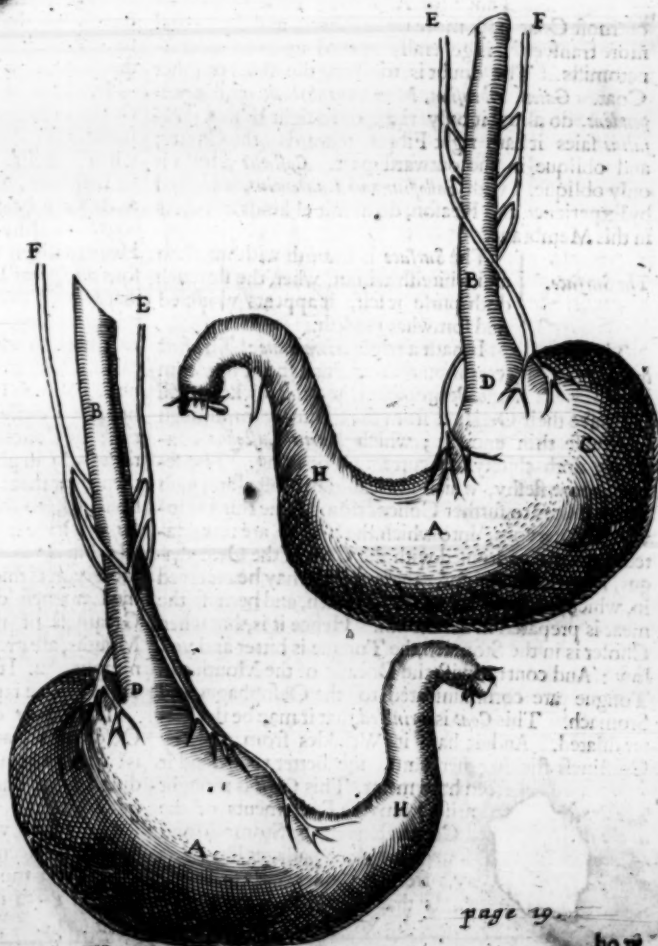
The Explication of the FIGURE.

- A. The Stomach.
- B. The Gullet or Oesophagus.
- C. The left and larger side of the stomach.
- D. The upper Orifice of the Stomach called peculiarly Stomachus, and Cardia the Heart.
- E. The right external Nerve of the sixth pare, compassing the Orifice thereof.
- F. The external left Nerve of the sixth pare.
- G. The Gastrick Vessels creeping along the Bottom.
- H. The lower Orifice or Mouth of the Stomach called Pylorus, the Porter.

the bowed back, and hath transverse Fibres, and a thicker Circle cast about it (others call them Glandulous Pustles) like an Orbicular or Sphincter Muscle [some call it by the Name of a Valve, though it be seldom so closely shut, but that both Dung and Choler, and other things do ever and anon ascend. But the Chylus by a Natural propension, affects to go downwards, nor doth it go the other way, unless compelled] It is called the Pylorus or Porter, because it lets out the Chyle:

It is sometimes exceedingly widened.

It may be exceedingly dilated, even as also the left. Hence it is that many examples testifie,



how that very great things have been swallowed down, and voided out by Vomit, and by Stool; as Gold-rings, Nut-shells, small Knives, Pebble-stones, peices of Iron, Frogs, Lizards, Serpents, whole Eels, Pipes,

Whether the Pylorus have any Rule over the inferior Parts?

Coins, &c. The Pylorus rules over all the inferior parts, according to the Opinion of Helmont, being Moderator of Digestion: From the Indignation whereof, he fetches the cause of the Palſie, and Swimming Dizziness of the Head; and saith that a Flint having stopped the ſame, Want of Appetite, and Death it self followed. Salmuth saw Death caused by the Gnawing and Scirrhous Tumor thereof, which Evils depend upon viciated Concoction, or Digestion hindered.

The Fibres of the Stomach and their use.

The Stomach hath three sorts of Fibres: straight, oblique, & transverse; which are conceived to serve for Attraction, Retention, and Expulsion. But some do peradventure more rightly determine, that the Fibres conduce to firmness and strength, as when we would have a peice of Cloath strong, we cause more threads to be woven into it: Especially seeing many other parts, without these kind of Fibres do attract, retain, and expel; as the Liver, Spleen, Brain, Stones, Lungs, Duggs. And other parts, as Bones and Gristles, though they have Fibres, yet do they not attract or expel any thing.

Their Number.

The Number of Fibres in the Membranes is uncertain, through the variance of Authors. That the first or outmost Coat hath more right Fibres, and the second more transverse, is generally agreed upon by most Anatomists. The doubt is touching the third or inner Coat. Galen, Avenſina, Mundinus, Sylvius, and Aquapendens, do allow it only right or straight Fibres. Vesalius saies it hath right Fibres towards the Cavity, and oblique in the outward part. Costaeus allows it only oblique. I with Fallopius and Laurentius, being led by Experience and Reason, do admit all kinds of Fibres in this Membrane.

The Surface.

The Surface is smooth without, plain and whitish within, when the stomach doth purse it self, it appears wrinkled and somewhat reddish.

The Membranes.

It hath a triple Membrane: The first common and external, springing from the Peritonæum, and the thickest of all that have their Original from the Peritonæum, though otherwise thin enough; which Petrus Castellus conceives doth chiefly concur in Vomiting. The second more fleshy, which is the middlemost, and hath fleshy Fibres to further Concoction. The third is lowest and nervous, into which the Vessels are terminated, and it is continued with the Coat of the Oesophagus, Mouth, and Lipps, that nothing may be received in, which is not grateful to the Stomach, and because the meat is prepared in the mouth. Hence it is, that when Cholera is in the Stomach, the Tongue is bitter and yellow: And contrariwise the Diseases of the Mouth and Tongue are communicated to the Oesophagus and Stomach. This Coat is wrinkled, that it may be the better dilated. And it hath its Wrinkles from a fleshy Crustiness sticking thereunto, the better to defend it from hard meats. This Crust is thought to arise from the Excrements of the third Concoction of the Stomach: and it is spongy, and hath passages like short Fibres, from the inner Surface to the outward: that the thinner Chylus may

The Crustiness in the Stomach whence it proceeds?

be the better detained till the End of Digestion.

The Substance therefore of the Stomach being membranous and cold, is holpen by the Heat of the Neighboring Parts. For the Liver lies over the right side, and middle part thereof; for it lies under the Heart-pit: At the left side lies the Spleen; it is covered by the far Call: Under it lies the Pancreas or Sweet-bread; also near it lie the Midriff, Colon-gut, the Trunk of Vena cava, and of the Aorta.

The Stomach is knit in the left part | Its Connexion. to the Midriff (not to the Back-bone) | by its Orifice; therefore when it is over full, by hindring the motion of the Midriff, it causes shortness of breath: On the right side it is joynted to the Gut Duodenum, by its other Orifice or the Pylorus.

At the Stomach, in the left side, under the Midriff, is formed a remarkable Cavity enclosed with Membranes, partly from the Stomach, partly from the Midriff, and partly from the Call. Touching this Cavity, that place of Hippocrates is to be understood in the 4 Aphorism of the 7. Section. *Those who have Flegm shut up between the Septum transversum and the Stomach, which causes pain, and can find no passage into either of the Bellies, when the Flegm passes through the Veins into the Bladder, their Disease is cured.*

The Shape of the Stomach is round and | Shape. oblong, like a Bag-pipe, especially if you consider it together with the Duodenum and Oesophagus. In the Fore-part is equally gibbous or bunching forth; in the Hinder-part, while it lies enclosed in the Body, it hath two bunchings, that on the right hand being the less, and that on the left hand the greater, between which lie the Vertebra's of the Back, and the descending Trunk of the Vena cava and the Artery.

Its Magnitude varies; commonly | Its Magnitude. tis less in Women than in Men, that place may be made for the Womb when it swells. For Women are for the most part less than men, and yet not more gluttonous than Men, as Aristotle beleives, viz. being of the same size and equally healthy; yea, and they are inferior to men in Heat to digest and concoct. Also in gluttonous persons and great Drinkers, it is greater than ordinary, so that when it swells, it may be felt as it were naked. For it is exceedingly dilated, and therefore it is thinner in Drinkers, in whom it is sometimes fo attenuated, that it can no more wrinkle it self, whence follows long weakness. Which Waleus in Dissection hath observed to happen chiefly to those old men, whose Stomachs in time of Concoction do breed Wind; which oftentimes also in gluttonous persons, takes up more room than their meat. Columbus will have it, when it is stretched, to reach as low as the Navil, and Archangelus will have it to reach further, when it is over stretched; but being contracted and wrinkled in such as live soberly, it is thick, and lies hid under the Liver. Now the Largeness of the Stomach is known. 1. By the Greatness of the Mouth, for those that have large Mouths, are great Eaters, but without bold and magnanimous. 2. If from the Cartilago Eniformis to the Navil, the space is greater, then that of the Face or Breast.

The weight of the Stomach being dried with the Oesophagus, according to the Observation of Iosephus is two ounces and two drams; wherein notwithstanding I have found a variety, according to the diversity of subjects.

It receives very many Vessels. Veins, as from the Spleen *Vas breve*, which is inserted, | Vessels. not into the mouth but into the bottom thereof, and there insinuating it self into the tunicles, it

creeps upwards between them, towards the Orifice: but before it reaches the same, it is obliterated; in some it is not visible, because of its smallness, in some it is quite absent [and therefore peradventure those persons have no good Concoction, or Nature Recompenes that defect with other Arteries] in others I have seen it flourishing, with manifold branches. And because it is implanted into the bottom of the stomach, and blood emptied there, cannot provoke Appetite, as

*Whether blood
cast out of the
Spleen help Ap-
petite and Con-
coction.*

many imagine. Others will have it that a Melancholick Excrement which could not be changed in the Spleen, is by this Vessel brought into the stomach, that by its harsh and acid faculty, it might further the stomachs Concoction, and make the meats abide

therein, a convenient season. But Concoction should rather be hindered, by the casting in of a strange Excrementitious Humor. If we shall interpret it touching an acid fermenting juice, the Opinion will be truer, which kind of juice, can come from no other place but the Spleen. For according to the Observation of *Waleus*, the Spleen, especially of a Sow, being boyled and eaten, as coming nearest that of a man, doth wont to help the heavyness and dullness of the Stomach. Hence sharp things are pleasing to the Spleen, and *Hippocrates* gives Vinegar to Spleenetic persons, and *Celsus* makes a Cataplasm for the Spleen tempered with the sharpest Vinegar. Moreover *Riolanus* hath found the left side of the inner part of the Stomach blacker than the right. Others suppose that nothing is carried into the stomach by the *Vas breve*, but that somewhat is carried out of the stomach into the Spleen; whether it be the thinner part of the Chyle, as *Comringius*, *Horslius*, and *Regius* prove, or Blood as *Hogeland* conceives; they being informed by Ligature in dissections of live Creatures: of which hereafter.

Moreover the stomach receives Veins from Vena Portæ, viz. the Pyloric, Gastric, and Gastroepiploic branches left and right.

There is one notable Vein called *Gastrica*, which creeps a long the bottom of the stomach, but doth not quite touch it least the stomach being very much stretched, it should be in danger to be broken; but it spreads many branches to the stomach: which *Picobomineus* and *Aquapendent* will have to suck out the more thin and subtile part of the Chyle, before it passes out of the stomach to the Liver. And this Opinion seems probable. 1. Because otherwise no reason can be given, of so sudden a passage, seeing they who have drunk much, do presently Piss it out plentifully. 2. Otherwise the stomach would be ready to burst, when it is overcharged. 3. Thence it comes, that strength is so soon repaired by fragrant Wine, broaths, and other comfortable things.

In some Men a part of the Choler passage, is inserted into the bottom of the stomach, by which our Country-men *Petrus Severinus*, would have choler to be carried into the stomach. But this is an Error of Nature, and therefore such persons are apt to vomit Choler, for they are exceeding Cholerick, such as *Galen*, *Vesalius*, *Fernelius*, and *Casseri* have observed. Such persons are said to be *Picrocholi* ano, vomiters of Choler.

The stomach receives Arteries from the *Celiaca Arteria*, which accompany the Veins, not only for life sake, but that blood may be supplied from the Heart, for nourishment, for that the stomach should be nourished with Chyle, is a false opinion and now out of date. Seeing it is nourished with blood, after the man-

ner of other parts (it is only delighted with the chyle) which is brought out of the Arteries; which blood flows back again to the Heart, according to the Doctrine of Circulation proved and asserted by the renowned *Waleus* in his Epistles. By the Splenic Arteries an acid sharp juice is conveyed into the stomach from the Spleen, as the said *Waleus* and *Hogeland* conceive, which I grant when there is no *Vas breve*, or in absence of the Spleen, wherein I easily consent with *Riolanus*.

Also it hath Nerves from the sixth pair, | *Its Nerves*. viz. a couple in its Orifice, from the stomach branches, being produced after it hath run back in the Chest and furnished the Lungs and Pericardium; which because they are soft and go a great way, they are covered with strong Membranes. And they do so cross one another, that they are carried obliquely and consequently with greater safety. The right branch compasses the fore and left part of the mouth of the stomach; the left the hinder and right part thereof. And therefore because the Orifice is so compassed with Nerves, as if it were altogether composed of Nerves thence it is that this Orifice of the stomach is exceeding sensible; for there was to be the fear of Appetite and hunger: even as those that are very hungry, do feel that part to be as it were contracted and wrinkled together. Also branches of Nerves are sent from these downwards to the very bottom. A branch goes from the left Nerve, a long the upper part of the stomach to the Pylorus, which it infolds with certain branches, and goes to the hollow of the Liver. Other two Nerves also go unto the bottom of the Stomach, from the branches which run along by the Roots of the Ribs. And therefore it is no wonder, that when the Brain is smitten and hurt, the Stomach is disturbed, and falls a vomiting, especially in the pain called *Hemicrania*: As also that when the Stomach is misaffected, the Animal Faculty languishes.

In the Stomach Fermentation of the | *The Stomachs*
Meats goes before Concoction, which | *Fermentation.*
Hippocrates inculcates in his book de Pri-
scia Medicina. Because hard things ought |
to be broken to peices; and thick things as bones and
shells, &c. in the stomachs of Beasts, seem impossible
to be melted by the natural heat alone, unless somewhat
else do cut them in peices. This labor *Petrus Severinus*
attributes to Choler, which nevertheless according
to the ordinary Course of Nature is not found in the
stomach, nor does it dissolve any hard meat, though
Painters use to temper their colours. *De la Chambre*
attributes it to Spirits, without which it can hardly be
performed, *Riolanus* supposes that it proceeds from
the Reliques of the Chyle, which have attained a fer-
menting faculty; it concurs indeed, for a fermentative
quality may be communicated to any thing: but we
must come to some first, thing, by which the Chylus
is fermented, and from whence the ferment of the
first meat was derived, before the Reliques of the
Chyle could arise. The greater part of Doctors do attribute
this whole work to Melancholy, which is carried
by the *Vas breve* into the stomach, and of which Mel-
ancholick persons, who are otherwise no good di-
gesters, do often complain by reason of its sharp taste.
Which Melancholy; if it be understood of the acid
juice, it may be allowed. For any acid or sharp
things taken in, as Vinegar, and Meats steeped there-
in, Juice of Citrons, Oyl of Sulphure or Vitriol,
Cream of Tartar, and the like, do ease and amend
the weakness of the stomach. Also with the Body
Vinegar ferments the Earth and Milk, even as black-
choler

choler doth, and the acidity of Vitriol ferments Treacle, and four leaven makes the bread arise, &c.

Three things requisite to Concoction, Now *Johannes Waleus* requires three things to Concoction, first some moisture to temper the meat and make it liquid, viz. Drink and Spittle; in the

next place, somewhat to cut and mince it as it were, as the thin sharp humor, and lastly somewhat to melt and make liquid that which is cut, such as is heat, wherewith in ravenous beasts and some Men, the chyle is made fluid, though they do not alwaies drink, I should not doubt, but that the Excrements of the third Concoction, sticking to the Crust, as being still imprægnated with the virtue of the parts nourished, do give some assistance to the Concoction, which when they are fretted of, is impaired, and so in long fasting men are not so able to digest: And that the spittle besides moistening and tempering the meats, doth perform some other more noble work in Concoction, viz. prepares the meat in the mouth, whereupon it comes to change its smells; and heals Tettors, and either kills or chafes away Scorpions and Spiders.

But what becomes of that acid Juyce, when it hath performed its office of fermentation? *H. Reginus* beleives that it remains after the expulsion of the Chylus, to prick the stomach and provoke Appetite. But hunger is raised in the sensible mouth of the stomach, and not in the bottom thereof, where this acid juyce is; also there would be hunger after the stomach is full. I should think that it is expelled with the Chyle, and that then it is either therewith turned into blood, or that in obstructions of the Mesentery, it goes downwards, and raises disturbance.

Concoction is the Stomachs Act. The Action of the stomach is *Codion* which is termed Chylification. For the stomach is the Organ of the first Concoction, the beginning and preparation of which Concoction is performed in the mouth, the middle in the bottom of the Stomach,

and the Conclusion in the smal Guts. Now **How it is made.** this Concoction is performed by heat, not of the stomach only, but also of the Neighbouring parts: as also by a faculty which is naturally bred in the stomach of every Animal. Now it turns the meats into a white Chylus or Juyce, of a like substance, whiles both its Orifices being shut very well, it contracts it self, and closely embraces the food. But touching the whole manner of Concoction see the forecited Epistles of *Waleus*.

The use of the Stomach. Its use is to receive the Meat and Drink, which it doth by reason of its notable and large Cavity. And whereas it sometimes contains and breeds little stones, as *Genislu* and *Zacutus* have observed, as also a Toad, Worms, and other things by me often observed; this is beside the Intention of Nature. And the like we may say of an Infant conceived and formed there and voided out at the mouth, the History whereof is described by *Salmuth*.

CHAP. X.

Of the Guts in General.

The Guts. **T**HE Guts are oblong, round, hollow bodies variously wreathed about, joyning with the Pylorus and reaching to the Fundament; serving to receive the Chylus and the Excrements of the first Concoction.

They have their name of *Intestina* inwards, because they are in the inmost seat of the Body [whence *Tertullian* call'd the Croffes, the *Intestina Trophæorum*, the inwards of the *Trophies*] and so the Greeks term them *Entera*; some have termed them *Chordæ*, and thence the Barbarians had their term *Chordæ*; for which cause also the strings of musical Instruments because they are made of dried Guts are termed *Chordæ*, Chords.

Their *Magnitude* in respect of the Contents of their Cavities, and the thickness of their substance, is different, as shall be shewn hereafter. The weight of all of them dried, is according to the observation of *Loßlius*, a pound. Their length, for the most part doth exceed the length of the person whose they are six times, little more or less. *Piccolomineus* saies they are a foot and half shorter; they are reckoned to be seven times as long by *Laurentius*, *Paræus* and *Riolanus*, and before them by *Celsus*, who nevertheless began to measure from the *Oesophagus*. *Hippocrates* saith they are near upon thirteen cubits, or not less then twelve: but the full stature of a man, hardly exceeds three Cubits and an half. *Flud* in a certain Body an ell and half long, found the Guts to be but nine ells in length, so that no certain Measure can be determined. It varies according to the Multitude of the windings, and the greediness of the person in point of eating.

They have turnings and windings all over save at the beginning and end, that the Ingress and Egress might not be hindered. Now the reason why they have these windings and turnings is.

1. That the nutriment may not slip away, before Concoction be perfectly finished. Also least if it should presently slip away, before the Chylus be distributed, we should be compelled presently to eat more meat, and so should be hindered from our business through greedyness of eating. Hence it is that living Creatures by how much the way is streighter from their stomach to their Vent, by so much the more greedy they are of eating; and the more their Guts are coiled, the more abstinent they are: which *Cabrolinus* observed in a very great eater, who had one only Gut, bowed after the manner of a Greek *Sigma*. 3. That we might not be continually going to stool, as it is with greedy Animals, seeing the Excrements may lie long in those windings.

They are situate in the lowest Belly, the greater Cavity whereof they fill up, sometimes they are forced to the right side, as I have seen in an Hydropick Woman dissected. They are knit together by the Mesentery, by which, and the Call coming between, they are tyed unto the Back, and are propped up in the Cavities of the *Os Ilij*.

They have a membranous Substance, like that of the Stomach; so that they may be distended by Chyle, Dung, and Wind. But their Substance is thicker in the thicker Guts: And the nearer they grow to an end, the thicker they are, as the End of the Colon, and the *Intestinum rectum*.

This Substance of the Guts may be divided into three Coats: The first is proper and internal, and is in the smal Guts wrinkled, in the Colon stretched out into little Cells, being otherwise sufficiently nervous. A certain inmembranous Crust as it were compasses about, bred of the Excrements of the third

Why called Intestina.

Their greatness

The use of the turnings and windings of the Guts.

Their Situation.

Their Substance.

Their Coats.

Their Crust.

The Stomach is seen open, and the Bowels beneath the same and Joyned thereto, much in their natural Situation.

The Explication of the FIGURE.

The X. TABLE.

- A. The Oesophagus or Gullet.
 B. The upper Orifice of the Stomach.
 bb. The Stomach Nerves embracing this Orifice, rudely expressed.
 C. Pylorus or the Porter.
 DD. The common ventricle of the Stomach separated.
 E. The first proper Coat of the Stomach, being the middlemost.
 F. The second proper Coat of the stomach, which is innermost and wrinkled.
 G. A portion of Duodenum.
 h. The passage for Gall.
 III. The Guts Jejunum and Ileum, with Vessels creeping through the same.
 K. The blind Gut, or the Worm-fashion'd Appendix.
 LLLL. The Gut Colon.
 M. The Valve in the beginning of the Gut Colon, opened.
 mm m. The Ligament containing the Cells of the Colon.
 NN. The straight Gut is here seen, the thin Guts lying thereon being removed.
 O. The Sphincter Muscle of the Fundament.
 PP. The Muscles which lift up the Fundament.



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Concoction of the Guts. 1. That the Mouths of the Mesaraick Veins may not be stopped. 2. That neither they nor the inner Coat might be made hard and callous, by the continual thoroughfare of the Chylus. Also the second is proper, and the middle most, being strong and furnished with fleshy Fibres. The third is common and external, being bred immediately of the Membranes of the Mesenterium [save that where the Duodenum and Colon cleave to the Stomach, it arises from the lower Membrane of the Call] but mediately from the Peritonæum. Of these two proper Membranes, the inner is often hurt in a dysentery or bloody Flux, that other remaining un-hurt.

They have Fibres. not only transverse, as is commonly conceived, but of all kinds: The innermost hath oblique ones: the middlemost hath transverse ones. The right Fibres which are allotted for the safeguard of the transverse ones, are fewer in the thin or small Guts, more in the large, especially the right or the last Gut, which was to be strong, because it did collect hard Excrements.

The Guts are covered on the outside with Fat, on the inside with a slimy snotty Substance, that the

Dung may thereby pass more freely, and that the Guts may be duller in point of feeling.

For Vessels they have the *Vena Lactæ* or milkie Veins, which are chiefly distributed between the common and proper Membranes, which carry the Chyle to the Liver; and others from the *Vena Porta*, which are conceived to bring Blood for Nourishment, but they rather carry back to the Liver the Blood which remains after the Guts have received their Nourishment. They have also Arteries from the *Cæliaca* for life, which by their motion preserve from putrefaction, but especially to bring Nourishment from the Spleen to the Guts, which wanted such kind of sustenance. They have Nerves from the sixth pair of Nerves. But *Waleus* conceives that the Guts have such great plenty of Arteries and Veins. 1. That Excrements might be conveyed to the common shore, which are contained in the Vessels, whence the Child in the Womb, though it take

no meat in at the mouth, yet hath it Excrements in the Guts. 2. That greater plenty of Blood might be carried through the *Vena portæ* and the Liver, and might come to be perfected by the Liver.

All the Guts are commonly divided, into the *thin*, or *small*, and the *thick*, or *large* Guts. For though they make one continued Channel from the Pylorus to the Fundament: Yet because this passage doth vary, in Magnitude, Number of Turnings, Substance, Situation, Figure, and Office, therefore is it distinguished into divers Guts.

Whether the thin Guts may be right said to be uppermost? The *thin* or small Guts, so called by reason of the thinness of their Membranes, are situate partly above, partly beneath the Navil; and therefore they possess both the Umbilical Region and Hypogastrium, which is not so in Dogs. Whereupon the *Ancients* taking Example from Dogs, called the upper Guts *thin*, the lower thick: which is false in Mankind. For a Man hath more of the thick Guts above his Navil, and more of the thin Guts beneath; seeing that which is the longest, is beneath; and the Jejunum which is short is above. And therefore all the small Guts are in the middle Region about the Navil. 1. Because they are the more noble. 2. That they may be the more near to the Centre of the Mesenterie, and consequently receive Veins and Arteries immediately from the Mesenterie, and quickly convey the Blood to the Liver. Now the small Guts are three: Duodenum, Jejunum, and Ileon. And these perfect and distribute the Chyle: In as much as by reason of their narrowness, every part of the Chylus may be touched, by their Coat and Vessels. This Distribution is holpen by the inbred Peristaltick motion, whereby the Guts are contracted from the upper part downwards.

The thick Guts. The *Crassa Intestina* or thick Guts, are so called, because they have thicker Coats; they contain the thick part of the Chyle: And are made to collect, and for a season retain the Dung. And they are three; Cæcum, Colon, and Rectum. And they are situate by the sides of the small Guts, which they wall about as it were, that they might give way to the thin Guts, and that the thin Guts might not be oppressed by the thick.

Their Use. The Use of all the Guts is, to be like the Earth, out of which the Mesaraick Veins suck Blood, and the *Vena Lactea* or milkie Veins suck Chyle. And the use of the *thin Guts* is, to concoct the Chylus yet more in the passage, and to distribute the same. Of the *thick Guts* to contain the Excrementitious Reliques of the Chyle, viz. the Dung; also Winds and Choler proceeding from the Liver. A Secondary use of the Guts being dried, is to cure pains of the Cholick, and other Diseases of the Guts; and being preternaturally depraved, to contain several sorts of Worms, and Dugges, and Stones; also variously to be affected, of which Physicians are wont to treat.

CHAP. XI.

Of the Guts in Particular.

The Gut Duodenum. **T**He first thin Gut, under which the Sweet-bread lies, especially in Dogs, is called DUODENUM. Galen terms it *Epiplois*, *Hieropbilus*, *Dodecadactylon*, as if it were

just twelve fingers long; though in the daies and Bodies of ours, it is not found so long; nay it is hardly four fingers long, unless men are grown less of stature then they were anciently, which is not credible. Nor can we understand the fingers breath, of which this Gut hardly attains to eight, unless peradventure the Ancients did also comprehend the Pylorus in their measuring.

It proceeds in the right side, from the Pylorus towards the Back-bone, or under the Stomach, where being joyned to the Vertebra's of the Loins, by membranous Ligaments, it defends right along, without any Circumvolution, and is terminated, where the Windings and Wreathings begin.

It is thicker then the rest of the thin Guts; but hath a more narrow Cavity, least the Chylus should slip in too fast. I saw a large one at Padua, and *Aquapendens* describes such another being puffed with Wind, such as that was, mentioned by *Trafelman*, which had in it many Stones as big as Nutmegs, of an Ash-color.

It hath two Holes beneath, towards the Gut Jejunum; the one being the outlet of the Exoler or Gall-carrying passage, which is the reason we find it yellow in our Dissections, the other is the new passage of the Pancreas or Sweet-bread, invented by *Wirsungus*; which I have notwithstanding sometimes seen grow together, and joyned with one only Mouth.

Its peculiar Use assigned by *Helmont*, is to change the acid Cream brought out of the Stomach, forthwith into a brackish-Salt.

It hath a proper Vein called *Vena duodena*. It hath an Artery from the right Branch of the Cæliaca.

The second is called JEJUNUM, because for the most part it is more empty then the rest, especially in Dissections. 1. By reason of the plenty and greatnes of the Mesaraicks [the milkie Veins] which in that place are as it were infinite, and do presently suck out of the greatest part of the Chyle. 2. By reason of the moistness of the Chyle passing through. 3. By reason of the nearness of the Liver. 4. By reason of the Acrimony of Choler. For the cholerick or Gall-passage, enters in at the beginning of this Gut, or at the End of the Duodenum, bringing Choler from the Liver to provoke Expulsion.

Its inner Membrane is longer then the Outer, and therefore it is wrinkled into Foles, the better to stop the Chyle, slipping by.

Riolanus saithly saies that Women have no Jejunum Intestinum, being deceived by those, who either were dull-sighted, or finding this Gut filled, thought it could not be the Jejunum. *Laurentius* observes, that it appears somewhat reddish, by reason of the Neighborhood of the Liver.

It hath Veins from the *Mesenterica dextra*, which are common to the rest of the Guts, excepting the last, or *rectum Intestinum*, the straight Gut.

It hath Arteries from the upper Mesenterick Artery. Nerves from a Branch of the sixth pair, which is spread out unto the Roots of the Ribs.

The third is called ILEON, because it is rouled so and twined, it is also for that cause termed *Volvulus*, by reason of many Circumvolutions, which make for the carriage of the Mear, and for that cause it hath fewer pleites or foldings.

It arises presently after the Jejunum, where few mesaraicks

The Holes of the said Gut.

The Gut Jejunum.

The Gut Ileon.

The Coats and Vessels of the Guts are explained in this TABLE

The FIGURES Explained.

The XI. TABLE

FIG. I. A Portion of the Gut together with the Mesaraick Vessels.

AA. A Portion of the Gut, as yet whole.

BB. The External Coat of the Gut separated, that the Carriage of the Vessels under it may be discerned.

CC. The middle Coat of the Guts, or the first proper Coat.

DEF. The Mesenterick Vessels, of which D points out the Vein, E the Artery, F the Nerve.

FIG. II. Expresses the Coats by themselves.

GG. The common Coat of the Guts separated.

H. The middle Coat of the Guts.

FIG. III.

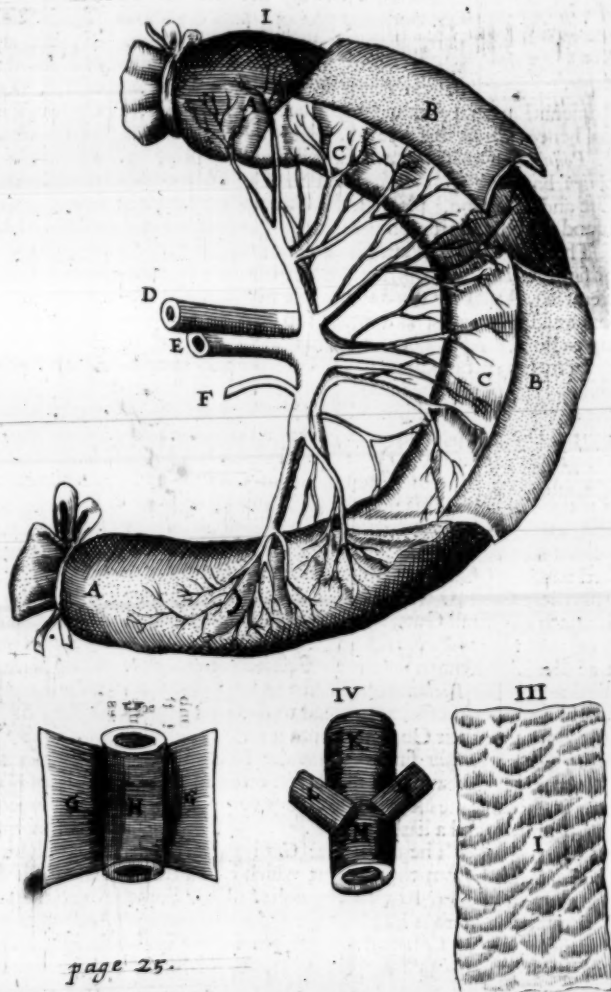
I. The inmost Coat of the Guts with its Plaies elegantly expressed.

FIG. IIII. Presents the Muscles of the Intestinum rectum, or straight Gut.

K. A Portion of Intestinum rectum, or straight Gut, or Arse-gut.

LL. The two Muscles called Levatores Ani, or Lifters up of the Fundament.

M. The Sphincter Muscle of the Arse.



saraick Veins are inserted.

It ends at the Cæcum.

It is situate under the Navil, at the Flanks and Hips on each side.

It is the longest Gut, being near upon twenty one hands breadths in length; it is one finger broad. But the Jejunum is not so long, viz. about twelve or thirteen Hands-breadth long, and the little fingers in breadth, unless it be puffed up with Wind. And as the Ileon is under the Navil, so the Jejunum possesses well near all the space about the Navil, with its very many turnings and windings.

Rupture of the Guts. This Ileon may frequently slip into the Cod, whence proceeds the *Hernia Intestinalis*, or Rupture of the Guts. And in this Gut happens the *Volvulus* or *Ileica Passio*, in which the Patient commonly vomits Dung.

The Passio Ileica. *Riolanus* hath observed sometimes three Appendices in this Gut, resembling the *Intestinum cæcum*.

The thick Guts. The first thick Gut is called *Cæcum*. I. Because of the obscure Use it hath in persons grown up, howbeit in the Infant in the Womb, it is said to receive the Excrements. *Knobloch* indeed

saith that it hath a double Orifice, severed with a membranous Partition, that by one it may receive from the Ileon, and by the other deliver into the Colon; but we have not yet found this in any man, in whom one and the same Orifice takes in and gives out. 2. Because it hath only one Hole, whence it is also called *Monocolon*. For it is a little Appendix like a long Worm, which arising from the beginning of Colon, and the End of Ilium, of a substance sufficiently thick, spreads it self upon the Colon like a twined worm, and is annexed to the Membrane of the Peritonæum; but by its End, it is joyned to the right Kidneys, the Peritonæum coming between, and is quite free and loose from the Mesenteric.

It is four fingers long, and as broad as ones thumb, but the Cavity thereof is very strait. *Riolanus* did find it exceeding wide, and equal to the Stoma it self, as I also have seen it. *Sylvius* did in many find it solid, without any fellowness, and in such persons the Dung does

does go immediately from the Ileon into the Colon. And *Massa* suspects that this Appendix is only bred when the Child being from its Birth troubled with a Looseness, the liquid Dung passing speedily by the Cæcum, and not abiding therein, being frustrated of its Office, it grows lean. Howbeit, I have seen it of the same thinness in a Child new born.

The Intestinum cæcum, or blind Gut of the Ancients.

The Ancients by the Cæcum understood that globous and capacious part, at the beginning of the Colon, which *Celsus* and *Rufus Epheſius* intimate. For that it was known to the Ancients, contrary to what *Laurentius* imagines, I do hence prove, because 1. They dissected Beasts. 2. *Pollux* and *Aristotle* have set it down distinctly. 3. *Galen* hath distinguished it from the Colon, both by Use and Situation, placing the Cæcum on the right Hand, and the Colon on the left.

The Use of the Cæcum is, not to be only for a mark or sign, as *Hofman* imagines, But first to receive Excrements, least they slip down violently into the Colon, and breed pains, and force us to be continually going to stool. And there some imagine the Dreggs or Excrements proceeding from cherries and cherry-stones, which have been voided forty daies after they were eaten, did lie lurking. The *Conciliator* contends, that the Dung is here separated from all chylous Matter. *Helmont* places the *Fermentum stercoreum* or turdile Leaven, which turns the Excrements of the Chyle into plain Turds, in this place. 2. It may help somewhat towards the Elaboration of the Chyle, either by sucking out of the white Mesaraick Veins some neglected parcels of Chyle, as *Galen* said, or by digesting the inobedient Chylus, which could not be tamed, in the Stomach and small Guts, by reason of the multitude of Food taken in, as *Zebus* supposes. 3. It may be instead of a Ligament to sustain the Peritonæum, least it fall down. But *Riolanus* observed this very Gut Cæcum in a certain Apothecary rouled to the Groin, and in little Boys into their Cod, in whom it rested upon the *Os sacrum*. *Severinus* suspects that the Reason why Dogs void their Dung with more then ordinary straining, is, because the cæcum is in Dogs very narrow at the beginning, and a little oblique.

The Gut Colon. The second thick Gut is called Colon, from the torment which is sometimes therein caused, by colick pains. Some think tis so called from its Hollownes, and because it shapes the Belly. Others derive it from a word signifying to delay, because it gives a stop to the Excrements that are in passage. The Author of a Treatise falsely ascribed to *Galen*, derives it a *colando*, from straining, because it is narrow like a strainer, and involved, that there may be a Gradation of the Excrement, and that it may not descend all at once.

Its Situation and Progress.

Its Situation is various, for its beginning which is capacious and round, is in the right Flank, arising from the cæcum at the right Kidney to which it sticks; then it is turned back upwards under the Liver, where it is sometimes knit to the Gall-bladder, and is thereby dyed with a clay-color yellowishness: It passes further, upward, under the bottom of the Stomach, and on the left hand is joyned to the Spleen, with thin Membranes, and then it is tyed to the left Kidney, where it hath very crooked Turnings, which are apt to detain both Dung and Wind; and from thence it ends straining, upon the Rectum. Wherefore it compasses the whole Belly, and sometimes ascends, and otherwhile descends (hence such as do

their business, have commonly one Harvest after another distinct) that the Excrements may be the longer detained, and not flow out all on a sudden, and that we may not every foot be sollicit to go to stool. To which intent also serve its Maggins and Cells. For;

It is commonly eight or nine hands-bread in length, and the thickest and widest of all the Guts.

It hath received Cells, that any hard Matter, not before sufficiently digested, might be perfectly concocted, and at last through the milkie Mesaraicks, which are carried to the Colon, that said Matter being concocted, might be sent unto the Liver. And that these Cells might not be dissolved, and that being collected into themselves, they might make the Cavities at times, sometimes greater, and sometimes less.

A Ligament described by few, or a certain Band, as broad as an half finger, is implanted through the middle thereof, on the upper part long-wise, and arising from the Cæcum, is terminated in the Rectum. Moreover by reason of its largeness, it hath two strong Ligaments, one upwards, another downwards, that it may be tyed to the upper and lower Parts. *Riolanus* nevertheless accounts these two Ligaments to be but one, opposite to the upper Ligament.

According to the Longitude of the Colon, there are extrinsically observed certain fat Appendices, from the Spleen to the beginning of the Rectum Intestinum, as *Riolanus* and *Spigelius* have observed. Whose use is to moisten the Gut, that the Excrements may slide down the more easily.

At the beginning of the Colon, a Valve is placed sufficiently thick and membranous, invented by *Baubin*, looking upwards, not downwards, as *Laurentius* writes: for the Excrements do ascend and not descend, when they pass out of the Ileon into the Colon, by reason of upper Situation of the Guts. But if the Natural setting of the Excrements be considered, they descend making haſt out of the Body: And thus *Bartholinus* and *Sperlingerus* are reconciled. The first Invention of this Valve, seems to be long unto *Salomon Albertus* an Anatomist of *Witteberg*, as appears in an Appendix to three Orations set forth by him, about the End, and from the Observations of *Schenkius*, Lib. 3. Title de *Ilio*. Howbeit, besides *Baubin* *Varolius* did also attribute the Invention thereof unto himself, who was a well known Anatomist in the University of *Padua*, in the year 1572. And therefore *Riolanus* conceives the first Invention thereof, ought to be attributed rather to him then *Baubin*; But truly, it is in vain that he seeks to bereave him of this commendation, seeing divers Persons may observe one and the same thing, at one or sundry times, without stealing the Invention one from another. For Nature lies open to all diligent Enquires.

It is found after this manner: Water poured or wind blown into the Gut Ileon, cannot pass through unless violently: But Water doth a little mar the Gut.

Touching its Figure or Shape and Number, Authors do not consent. For omitting such as wholly deny the same; *Baubin* determines that it is only one, having the figure of a Nail. *Archangelus* saith, that there are three Valves at the Cæcum, as in the Heart, looking downwards. I have sought it at *Padua* in many Bodies, and at other places, and alwaies found it, but never more then one, and that of an orbicular or circular Shape. *Pavius* to *Hildanus* and afterwards *Falcobergius*, did not find out a membranous Valve, but rather a Ring or Circle with an hanging brim. But the said Circle is nothing but a Valve, for some Valves are found

found of a circular Figure, both in the Heart, and in other Veins. The whole constitution of this Valve is elegantly described by that great Practitioner *Nicholas Tulpius*, that it is a Circle on which hangs a Membrane, two fingers broad, and so shaped that it is fit to shut the egress of *Intestinum Ileum*. Before which there hangs a Curtin or slack veile as it were; now the latitude of this Pendulous Membrane is very unequal; for where it looks towards the Ileum, it diffuses it self loosely, to the quantity of near two fingers breadth, but the farther from the place it is, the closer it is strait'ned, so that about the middle of the Gut (for so far it runs) it is either quite obliterated, and ends into that Membranous compass, which inwardly severs the *Intestinum Colon* a *Cæco*. From which unequal latitude, there follows necessarily that same circular form, which the value expresses being artificially extended: as the smaller picture faithfully expresses. Now this Membrane is fastned above to that same fibrous circle which ends the Colon, but it is fastned below or rather strongly held, by two very little Membranes, proceeding on both sides from the side of that Orifice, through which the thinner Guts disburthen themselves into the wider: the use of which bones, is to hinder that the value do not easily totter, for they bind it to the Ileum: But the lower part of the value doth wave up and down loosely.

The use thereof is, that nothing may pass back out of the thick Guts into the thin, be it Wind or Excrement, especially in a strong excretion or straining at stool, or in costiveness of the Belly. Hence it is, that the matter of Clysters cannot naturally reach unto the final Guts.

The Colon hath *Veins* and *Arteries* under the Stomach from the *Epiplois postica*. But in the left side it hath the *Hæmorrhoidal Vein*, and from the lower Mesenterick, the *Hæmorrhoidal Artery*.

The last thick Gut is termed *Ræctum*, because it goes straight out, without any turning, and ends at the Fundament: for it goes streight downwards, from the top of the Os Sacrum to the extremity of the Crupper-bone, to which it is *Knit* firmly, by the *Peritonæum*, least it fall of: also it grows in men to the Pispipe in the Yard; to the Neck of the Womb in Women, by mediation of a Musculous substance. Whence springs the consent of these parts in Men and Women, especially of the Womb and this Gut in Women. for the Gut being ulcerated, oft-times the Excrement is cast out the female Privity.

It is long, as it were an Hand-breath and an half, and three fingers broad; and Corpulent and thick, having Fat Appurtenances, growing thereto on the outside.

It hath *Veins* from the Hypogastrick branch of the *Vena Cava*, and *Hæmorrhoidal Veins*.

Four *Nerves* are inserted into the end thereof, which make this Gut very sensible, as is apparent in the *Tenesmus*.

Its end is termed *Podex* or *Anus*, the *Arse* or *Fundament*, having three Muscles, of which peradventure five may be made. The,

The *Intestinum rectum*, or the straight Gut.

Touching the Fundament.

This TABLE sets forth that Valve which is found in the Guts.

The Explication of the FIGURE.

- a. The Gut Ileum.
- b. Cæcum or the blind Gut.
- ccc. Colon.
- dddd. The valve hanging.
- e. The entrance of the Gut Ileum.
- fffff. The Gut Colon slit open.
- gg. The inner coat of the Gut Colon.
- bbb. The Valve lifted up.
- i. The beginning of the Gut Ileum.
- kkk. The Circle.
- l. Its Connexion with the Ileum.

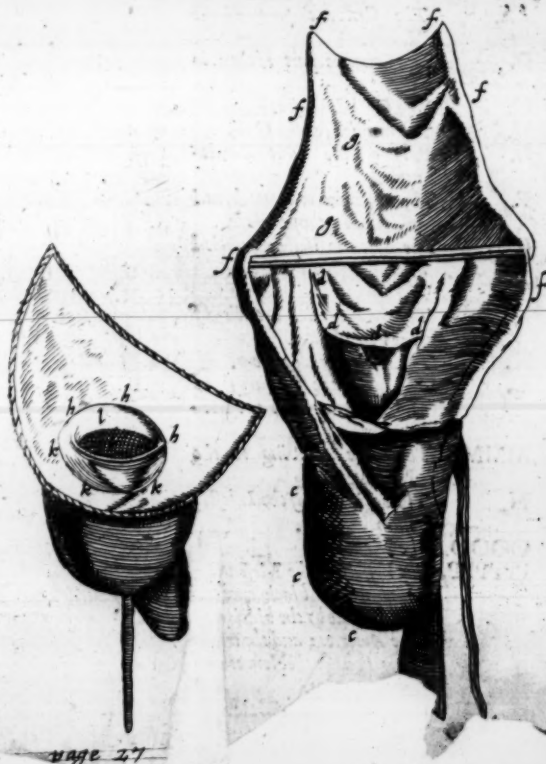
The Sphincter Muscle.

I. Is termed *Sphincter* or *Ani Constrictor*, the shutter or contractor of the Fundament, so that though some part thereof may be cut of in *Fistula's* or other Diseases, yet is not therefore the whole use thereof, quite taken away.

Galen and *Fallopius* and others do make two of this Muscle, because its upper part is thicker; the inferior part is inseparably annexed to the Skin, as is seen in the Fore-head and Eye-lids, and therefore *Galen* called this part the skinny Muscle, or the fleshy Skin.

It arises from the lower Vertebra's of Os sacrum and is compassed with transverse Fibres all a long the Fundament.

The XII. TABLE.



It is fastened on the forepart. 1. To the passage of the Bladder, by Fibrous couplings. 2. To the Yard, to the Muscles whereof it gives beginning. 3. To the Neck of the Womb. Behind to the Crupper-bone which lies under it. At the sides, by Ligaments produced from the *Os sacrum*, into the *Os Coræ*.

Its use is, to purl up the Fundament, that we may do our business when we please. And therefore being palsied or otherwise hurt, it makes the dung to come from a man whether he will or no: even as the Sphincter of the Bladder being hurt, the piss flows out involuntarily.

The Muscles call'd Ani Levatores, or Arse-lifters. II. and III. Two other Muscles have insertions into the upper part of the Sphincter, very much Com-mixed therewith. They are call'd *Ani Levatores Arse-lifters*. Because,

Their use is to draw the Fundament upwards into its own place again, after the Excrements are voided. especially when we have been forced to strain hard at stool. And therefore when they have been weakened or slack'd, sometimes the Fundament is drawn up with difficulty, and sometimes it continues hanging forth.

These Muscles are under the Bladder broad and thin, arising from the Ligaments of the Share, the

Os sacrum and Hip: from whence they are carried downwards, to the right and left sides of the Fundament, which they compass about. But they have a certain peculiar and distinct portion, growing to the Root and Neck of the Yard, which may be counted a third and distinct Muscle. The use of these Muscles ceases in those who have their Fundament shut up. Such a Case *Fernalius* saw, And I saw the like at *Padua* in one named *Anna*, whose Fundament was so shut up, that he voided his Excrements by his mouth when concoction was finished, having an Horn to put into his mouth for that end.

Chap. XII. Of the Mesentery.

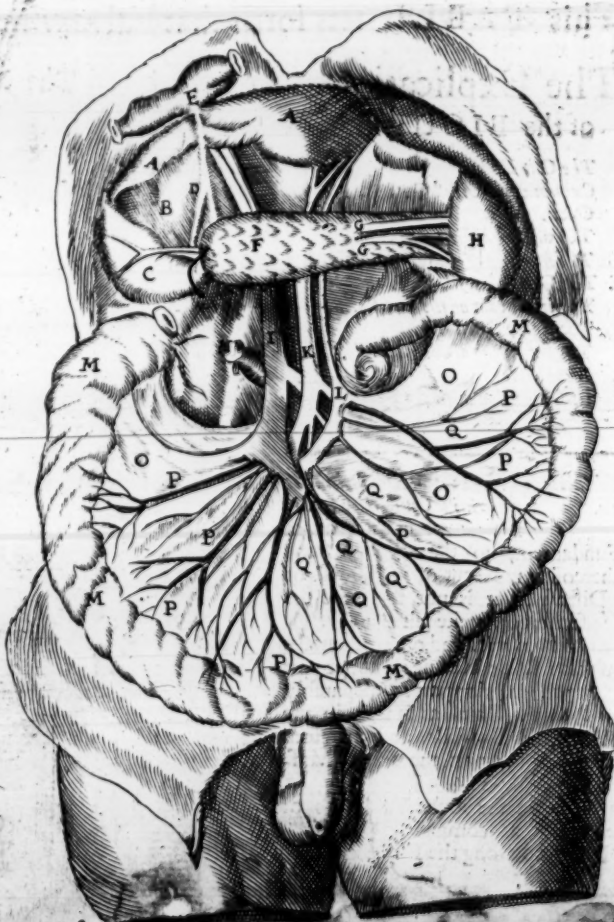
THE Mesenterium is so called, because it is in the middle of the Guts, not because it is the middle Gut as *Cicero* will have it [and *Macrobius* who follows him; for it doth not partake of the nature of a Gut, save in that it is Membranous, nor is there any defence for *Laurembergius*, because we are rightly said to dwell in the middle of the world, supposing the Earth to be a part of the World. *Spigelius* doth more rightly inter-

Here are described four kinds of Vessels disseminated through the Mesenterium, as also the Pancreas is discovered, in its Natural Situation,

The XIII. TABLE,

The Explication of the FIGURE.

- AA. The Convexa part of the Liver.
B. The Concave part of the Liver.
C. The Gall-Bladder.
D. The passage for the Gall.
E. Part of the Gut Duodenum.
F. The Pancreas or Sweet-bread whole in its proper place.
GG. The Splenic Vessels detected by opening the Pancreas.
H. The Spleen.
II. The Mesenterick branch of the Vena Portæ.
K. The Mesenterick Artery.
L. A Nerve of the sixth pair spread up and down in the Mesentery.
MMMM. The Guts cleaving to the Mesentery.
N. The beginning of the Intestinum Jejunum.
OOOO. The Mesentery.
PPPPPP. The Vessels of the Mesentery, of which the black ones the Veins, those by the black ones the Arteries; and the white ones signifie the Nerves and the Veins.



This TABLE expresses the Mesentery taken out of the Body.

The Explication of the Figure.

- A. The Centre of the Mesentery, and that part of the Back, where it arises from the Membranes of the Peritonæum, which knit the great Artery and the Vena Cava in this place, to the Vertebra's.
- BB. The great Kernel of the Mesentery, which *Asellius* terms Pancreas, into which all the milkie Vains are knit together.
- CC. Glandules or Kernels placed between the Vessels, which reach as far as to the Guts.
- DD.EEE. Part of the Mesentery which ties the thin Guts to the Back.
- F.G. Part of the Mesentery which is fastned to the Colon, from the right Kidney to the Liver.
- G.H. The Membrane of the lower Call, which in this place supplies the Office of the Mesentery, fastening that part of the Colon, which is stretched out under the bottom of the stomach, unto the Back.
- H.I. Part of the Mesentery, knitting together the Colon, drawn out from the Spleen to the straight Gut.
- I.K. Part of the Mesentery, fastning the straight Gut unto the Back.
- L. The two Membranes of the Mesenterium, drawn asunder by the Nails, between which Vessels are carried, and the Fat and Kernels are contained.
- M. The first Membrane of the Mesentery.
- N. The other Membrane of the Mesentery.

The XIV. TABLE



page 29

K

pret the word *Intestinum* in Cicero, for some midling bowel] but because like a Circle it embraces the Guts round, and gathers them together into the form of a Globe, and cloaths them. Tis called also *Mesaraeum*: *Gaza* in *Aristotle* translates it *Lacies* [in a large sense] thereby understanding that which involves and wraps up the *Lacies* that is the Guts, and what ever is contained in them.

Its Division. It is one; but others divide it into the *Mesaraeum* or *Mesenterium*, and the *Meso-Colon*. The former being in the middle of the belly and knitting together the small Guts: the latter which knits up the Colon, in the right and left side and in the lower part thereof, cleaves to the right Gut.

Its Figure. It hath been narrow in its rise, in its progress, at the Circumference it degenerates into very many foldings, that it might gather in the length of the Guts: for one hands breadth of the Mesentery, doth embrace more then fourteen hands-breadths of the Guts in a narrow space. In the sides it becomes oblong, especially on the left side, where it descends to the *Intestinum rectum*. Whereupon *Galen* made a threefold Mesentery: a right, left and middle.

Its Magnitude. Its Magnitude from the Centre to the Circumference is a span: but its Longitude and Circumference is three ells.

Its Rise. It Arises at the first and third Vertebra of the Loyns, [which is thought to be the Cause of that great consent which is between the

Loyns and the Guts] where Membranous Fibres are produced from the Peritonæum, which turn into strong Membranes,

Through which the *Mesaraick Veins* [its Vessels, both the Blood and the Chyle-bearers] being exceeding small and numerous, and by little and little running together into fewer and greater, are disseminated. [But of these more largely in the first Manual Chap. 3.] And after the same manner the Arteries: [from the *Celiacæ*, that they may carry arterial blood with heat to the Mesentery and Guts for the Nutrition and Fermentation of each of them and in no wise to draw chyle in a sound state of Body, or other things as *Varolius* and *Spigelius* conceit. And that the blood is Circulated even in the Mesentery, by means of these Arteries, I shall demonstrate hereafter against *Riolanus*.] It receives also Nerves from those which are carried from the sixth pair, to the roots of the Ribs, as also from the Nerves proceeding from the Vertebra's of the Loyns, that they may give the sense of Feeling to the Mesentery, as is manifest in the bastard colick and other pains: and an obscure motion in distribution of the chyle.

It hath Kernels interposed to fill up the [its Kernels, spaces, and to cherish the heat: but one greater then the rest it hath at its original which *Asellius* following *Fallopius*, terms Pancreas: different from the other Pancreas situate under the Stomach and Duodenum. Out of this he fetches the Original of the milky Veins, with probability enough, because there they grow all into one, and from hence are carried both downwards and upwards to the Liver. Add hereunto, that it is in color like those Veins; and the

M

Veins

Veins themselves have in this place somewhat proper, viz. that they are interwoven in the whole Body of this Pancreas, with wonderful turnings, twistings, and twinings.

It is surrounded with Fat as in the Call, which proceeds from fat blood split out of the Vessels, and retained by the density of the Membranes, and so congealed: that it may cherish the Heat of those Parts, and further the preparation of Chyle.

The Use of the Kernels. The Use of these Kernels is, 1. To prop up and support sundry Distributions of the Branches of *Vena porta* and *Arteria magna*. Hence it is, that about the Centre of the Mesenterie are the greatest Kernels, because there is the Distribution of the greater and more collected Vessels. Moreover, these Glandules or Kernels, when they are at any time troubled with a scirrhous hard Tumor; there follows a Leanness of the whole Body, because they bear hard, and lie upon the branches of the *Vena porta*, and of the milkie Vein, so that the Nourishment cannot be freely carried through the said Veins. 2. To moisten the Guts, with the Humors which they suck out of the Parts, and promote Digestion by way of boyling as it were. Which Use *Spigelius* denies, because there are Animals that have not these Glandules, and nevertheless are fat; and others though they have these, are lean. Which may happen without any prejudice to my assertion, because these former Animals have such good Juice, as needs no purification; the latter have so little nutritive Juice, that it cannot sufficiently be depurated by these Glandules. And therefore, 3. They serve to suck superfluous Humors out of the Guts, which was *Hippocrates* his Opinion. I add 4. A peculiar Use, viz. to receive that plenty of milkie Veins which passes that way, and to keep some portion of the Chyle, because 1. It is of like use with that greater middle Kernel, and its substance is the same with that which exceeds this only in magnitude, because greater milkie Veins pass that way. 2. I observed that in Fishes, especially in a Lump-fish male and female, besides the great white one, the others did also send forth a white Juice. 3. This being granted, both Atrophia and other Diseases are better understood, to which Opinion also *Ayllius* seems to have inclined. And whereas *Riolanus* makes the Seat and Root of all Kings-evil swellings to be in these Kernels, and saith they never shew themselves on the outside of the Body, except the Mesenterie be first diseased with the same kind of Swellings, is not likely, for 1. Though they may be remote and accidental causes. 2. There is no communion between these kind of Swellings in the Head, and the Kernels of the Mesenterie. 3. Many have the Kings-evil swellings, in whom these Kernels are perfectly sound. 4. All would be subject to such Swellings, because all have these Kernels. 5. Those people dwelling under the *Alpes*, that are so subject to these Swellings, should have their Mesenterie differing from those that are not so troubled. 6. The said Swellings are filled by any kind of Humor proceeding from any Region of the Body.

The Use of the Mesenterie.

And of its Membranes.

The Use of the Mesenterie is to be the common Band of the Guts, whereby they are knit to the Vertebra's of the Loins.

And the Use of its two Membranes, is that through them the Vessels may pass safer unto the Guts.

Chap. XIII. Of the Pancreas, or Sweet-bread.

THE Word *Pancreas* signifies *All-flesh*, whereas this part should rather be call'd *All-kernel*, its Substance being wholly glandulous, loose it is and shapeless, three or four fingers long, sometimes six or seven, and more; clothed with a thin Membrane from the Peritonæum; and in fat Bodies, it seems all made of Fat, which others term dirty fat and moisture; some *Calicreas* the Sweet-bread or White-bread, and *Lactes*; because of its milkie whiteness and softness.

Its Situation is under the lower part of the Stomach, and the bottom thereof, the Duodenum and *Vena porta*, as far as the Regions of the Liver and Spleen.

Now its Original is at the first Vertebra of the Loins. In the middle its Parenchyma is white.

And it hath for Veins the Splenic Branch; for Arteries the left Branch of *Arteria Celiac*a; for Nerves those of the sixth pares branches, which go to the Stomach and Duodenum, and it hath also little Kernels.

Besides all which, it hath also another Passage which is membranous, and of a peculiar Nature by itself, spread out all along the Pancreas, sometimes in a straight Line, sometimes in a crooked Line, which hath been as yet described by no Anatomist, being first discovered at Padua, when I was there, in the year 1642. by *Jobst George Verslingus*, a very diligent Anatomist, but killed by cruel Fate; it is remarkable for its Cavity, and the strength of the Walls thereof. I beleive *Fallopins* did not know it. He mentions indeed small Passages, ending into the Pancreas and Kernels next it; but because this passage is only one, he rather saw through a mist the milkie Veins, dispersed into the Pancreas of the Mesenterie and other Kernels. It is for the most part single, though the same Party had found it double running one by another in parallel Lines: A short one in the ordinary place, and beneath it a larger. The Orifice whereof opens widely into the Gut Duodenum, near the Entrance of the Gall-passage, with which it is sometimes joyned by one and the same Mouth, but more frequently (as I found with the Author) by a different but neighboring Circle. The little Valve situate before the egress thereof, looking outwards, keeps the Probe from entering this new passage, being thrust in by the Duodenum. And therefore in a Living creature, being bound towards the Gut, it swells more and more, but beyond it is presently emptyed, if we beleive *Jacobus Baccius*, which is an Experiment hard to make for before that this passage which lies intangled and encombred can be freed, or bound, the Creature dies. From thence this passage creeps through the whole Body of the Pancreas, spreading out on both sides infinite little Branches, until by narrower but orderly disposed twigs, it goes by little and little straight forward, and is silently terminated towards the Spleen. But it goes not into the Spleen, although *Folius* hath assured me, that he hath observed it to go thereinto. Peradventure that was against Nature, nor seems it feasible, because the Branches are first obliterated by an orderly defect, ere they touch the Spleen, and there is no cavity there about, though an eminent one towards the

The Substance of the Pancreas.

Its Situation.

Original.

Its Vessels.

In this **T A B L E** both the Body of the Pancreas together with the new *Wirsungian Passage*, as also the Vessels drawn there through to the Spleen, are expressed.

The XV. TABLE,

The Explication
of the FIGURES.

FIG. I.

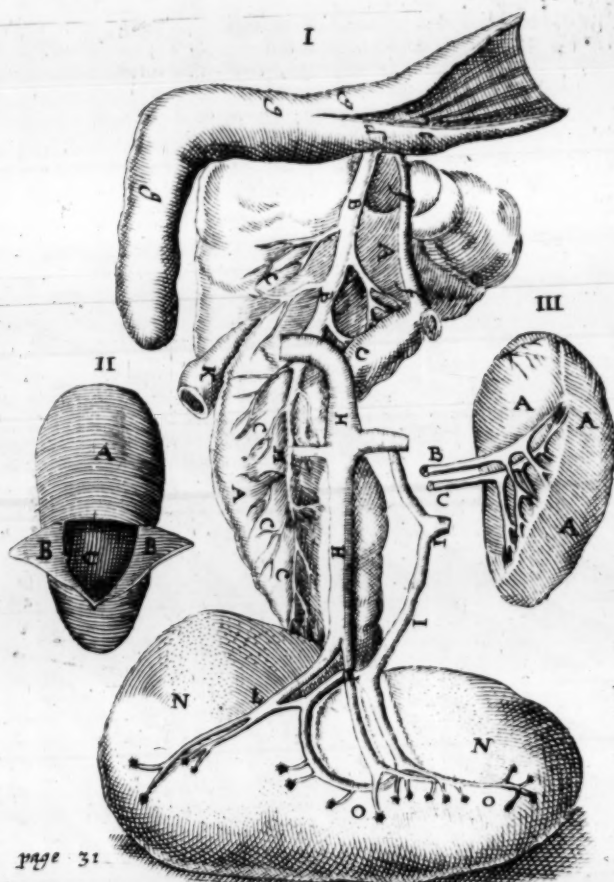
- AAA. The Pancreas dissected.
BB. The new Passage found in the Pancreas.
ccc. Little Branches of the said Passage.
d. The Orifice thereof.
e. The Orifice of the Choler-passage.
ff. The Choler-passage.
ggg. Part of the Gut Duodenum.
HH. The Ramus Splenicus.
II. The Splenic Artery.
K. A Portion of the Arteria Celiaca.
LLL. Anastomoses or Conjunctions of the Mouths of the Splenic Vein and Artery.
M. The Hemorrhoidal Branch of the Splenic Vein.
NN. The Body of the Spleen.
OO. The Ingress of the Vessels in the Spleen.

FIG. II.

- A. The convex part of the Spleen.
BB. The Splenic Membrane separated.
C. The flesh of the Spleen, which is blackish.

FIG. III.

- AAA. The concave part of the Spleen which receives the Vessels.
B. The splenic Vein.
C. The splenic Artery.



the Guts. In which Cavity (truly) there is no conspicuous Humor, save that a Probe being thrust in, is for the most part drier with a yellow cholerick colour, the Walls thereof being coloured with the like tincture, so that Choler seems to be therein contained, by the ordinary Law of Nature, which *Jobannes van Horn* likewise a Friend of mine saw at *Venice*, in a cholerick loofness, the said Vessel being evidently full of Gall or Choler. And therefore this new found passages

Use, is not to carry Chylus out of the
Its Use. Duodenum into the Spleen, so use 1.
It doth not reach to the Spleen. 2. A

Valve hinders the Ingress. Nor doth it serve to carry Melancholy out of the Spleen, to which use serve the *Capsula atrabilariae*, the black Choler boxes. Nor to carry fermentative Juice unto the Stomach, as *Horstius Junior* ingeniously feigns, Because 1. Such Juice is not bred in the Pancreas, which is a glandulous Body. 2. The way is more ready to that purpose, from the Spleen; this being a more troublesome and encombered passage, for it would be troubled by meeting the Chylus in the Duodenum, and would be infected by

the nearness of the Gall-passage. 3. Never any such Juice seen in this passage. 4. Who will be bound that it shall be able to pass beyond the Pylorus? Nor is it to prepare Chylus, which *Baccius* affirms to be found in living Creatures. Nor to nourish the Pancreas, seeing that Humor is therefore unfit, and the coeliac Arteries do that work, but for the common good. But how, or which way shall it return to the Liver? For he rightly denies it to the Spleen. Shall it return to the Duodenum, and from thence to the Mesentery? There would be an infinite Circulation. He shall not easily find it in living Anatomies; also he confounds the Pancreas with the large Kernel of the Mesentery. Nor finally does it send the Excrements of the Chyle to the Duodenum, as *Licetus*, *Riolanus*, and *Veslingus* conceive; for in this Passage no Chyle is seen, but yellow Walls. Moreover the refuse of the Chyle is already voided by stool, nor does the Chyle part with any new Excrement, till it undergo a new change in the Veins of the Liver. Now sure it is, that out of the
Pancreas

Pancreas it self, whose proper passage it is, and in which it begins, and is ended, somewhat is thereby voided into the Guts, and it doth as I conjecture.

1. *Purge forth Choler*, whether bred in the Digestion of the Pancreas, or in the Spleen, for each of these are taken to be Auxiliary Livers. And it is as it were the Bladder-gall of the Spleen, which is conveniently joyned by its mouth, to the other passage of the Livers-Gall-bladder, by the Duodenum, so that look what use the one affords to the Liver, the same the other may be supposed to afford to the Spleen. And to prevent our doubting, the Humor of Choler daubs the inside of this Passage. To which Opinion of mine, very many Learned men have asserted, though in some things they dissent.

2. To receive into it self the Excrements of Arterial Blood from the Heart and Spleen, though the neighboring Branches of *Arteria Celiacæ*.

3. *Riolanus* counts it a profitable Use, that by this Passage, in vomiting, divers Humors are purged out, and the Redundancies of the first Region; and consequently the fomenting Humors which maintain long-lasting and malignant Feavers and chronical Diseases, and which lurks in the Pancreas, is this way voided forth. And I may well ad somewhat to this most learned Invention. That not only by Vomit, but also by stool, through the assistance of Choler-purgers, hot cholerick Distempers may be by this Passage discharged, which burn the Mesentery, Spleen, Arteries, and Heart it self. And hence proceed cholerick stools in burning Feavers, and blood in a Dysentery or Bloody-flux, by reason of the large Inundation of Choler, continually flowing from hence into the Guts; which is so much the more hard to cure, by how much the Pancreas doth lie out of the reach of Medicaments, being deeply whelmed among the Bowels.

The Use of the Pancreas it self is, 1. To prop and support Vessels passing through the same, as the Branches of *Vena porta*, of the *Cœliack* Artery, and of the Nerves: Especially the *Ramus Splenicus*. 2. To assist the Concoction of the Stomach, which is performed in Heat and Moisture. 3. To serve as a cushion under the Stomach. And therefore that old Woman of Rome in whom it was become stoney, fell first into a continual Vomiting, afterwards into an Atrophy or consuming of flesh, and at last died thereof, as *Panarolus* hath it in his Observations. 4. To suck out the wheyish Blood which slides along that way, and through help of the Kidneys to purge it. 5. In sickly and melancholick Bodies, to perform the Office of the Spleen, which *Riolanus* shews from the Example of the most renowned *Tbuanus*: Whose Pancreas or Sweetbread, did equal the Liver in amplitude and weight, yet was it wholly scirrhus; but his Liver hard and round as a ball, and full of Flegm like Potters-clay, and his Spleen was found so small, that it hardly weighed an ounce.

CHAP. XIV.

Touching the Liver.

AND so much may suffice to have said touching the Organs destined to primary Digestion or Chylification, we come now to those which are any waies assisting the second Concoction or Sanguification. And the Principal of these is the Liver.

The Liver is an Organick Part seated in the Lower Belly, just under the Diaphragma or Midriff, on the right side, being the Organ of Blood-making, and the beginning of the Veins.

It hath its Name in Greek, from a Word that signifies want or Indigency, because it supplies the want of the Parts of the Body, the Latins call it *Jecur*, as if you would say *juxta Cor*, near the Heart. 'Tis called the Principle or Beginning of the Veins, because therein the Roots of two of the greatest Veins appear dispersed, viz. of the *Cava* and *Porta*, as Roots implanted in the Earth. The milkie Veins are supposed to arise from the Pancreas: Yet Trunks and Branches of them are also to be seen in the Liver. Now the Roots of Trees dispersed in the Earth, do grow together into a Trunk without the Earth. The *Vena arteriosa* of the Heart, is in truth an Artery: And the *Arteria venosa*, is a Vein, and may owe its Original to the Liver, because in a Child in the Womb, it is joyned with the *cava*, and opens it self thereinto by an Anastomosis: And besides, it carries Blood to the Heart, but brings none from it, if there be any force in this Argument.

The Liver is commonly but one in Number, seldom two: And more seldom is the Liver quite wanting, as in *Matthias Ortellus*.

Its Number.

It is situate in the lowest Belly, under the *Septum transversum* (which also *Hippocrates* and *Aristotle* acknowledged) by the Ribs, and for the greater part in the right Hypochondrium, a fingers breadth distant there from, that the motion thereof might not be hindered: Therefore a Swelling in the Liver causes shortness of breath. In Birds it lies equally on both sides: As also for the most part in Dogs which have a thin and long Spleen. In Man it seldom changes its place, so as the Liver should be in the left, the Spleen in the right side, which *Gemma* and *Spererius* have observed. It rests lightly upon the former and upper part of the Stomach, especially on the right side, for otherwise some part thereof reaches to the left side also, and sometimes the greatest part, the Spleen being very small. But some conceive that *Aristotle* was ignorant of the Situation of the Liver, because the said *Huper de to Diazona*, &c. which they interpret, above the Septum is the Liver seated. But the Philosopher is thus to be translated: It is placed on the other side, or beyond the *Septum transversum*; for *Huper* with an Accusative signifies beyond, but with a Genitive, it signifies above.

Its Situation.

And by reason of the Midriff, to which it was to give way, it hath its upper and outward Figure sufficiently round, convex or gibbous, even and smooth, where also there is an oblong Cavity, behind at the Passage of *Vena cava*. And because of the Stomach it hath received a Figure which is hollow on the inner and lower side, which is termed its fimosus or saddle side, and it is more uneven then the other having in it two hollowneses: One on the right hand for the Gall-bladder; another on the left, for the Stomach to pass by. So that the Liver is on the right side of an ample roundness, but on the left it is narrow and sharp.

Its Figure.

The Liver is divided by some, into the right and left part: between which there is a final cleft or chink, where the Umbilical Vein enters. Otherwise for the most part, it is entire in a Man and undivided, save that *Spigelius* observed here a certain

Its Division.

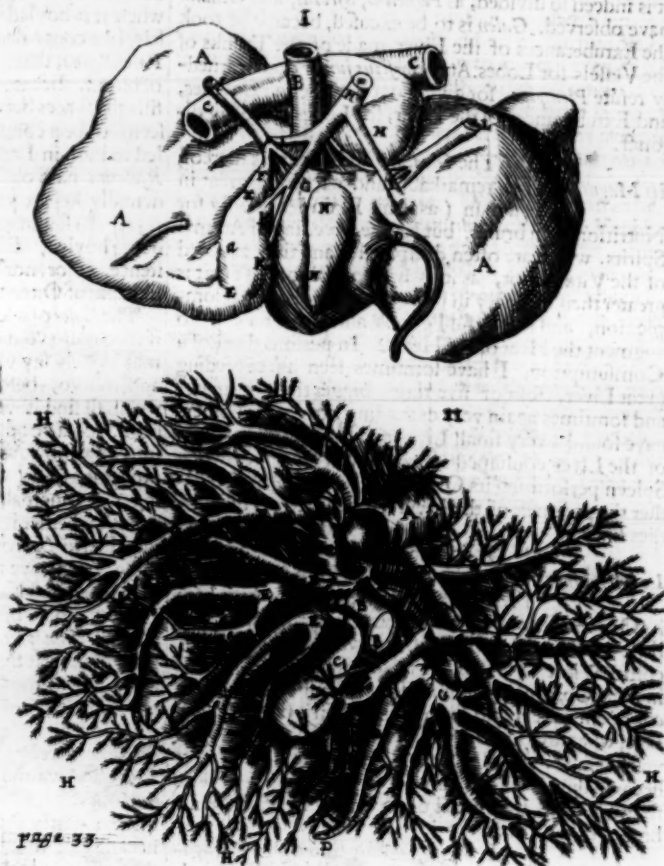
A Mans Liver is not divided into Laps or Scollops.

The Explication of the FIGURES.

FIG. I. Expresses the Liver taken out of the Body, and especially the hollow side thereof.

The XVI. TABLE.

- AAA. The Liver in its hollow side, clothed with its Coat and ragged Nap.
- B. The Vena Portæ, and its Egress out of the hollow side of the Liver.
- CC. Two Trunks of Vena Cava, by the tubercle or bossie part of the Liver.
- D. The going forth of the Navil-Vein from out the Liver.
- EE. The Gall-bladder seated in the hollow part of the Liver.
- F. The Gall-passage, called Cysticus Felleus.
- G. The other Gall-passage called Hepaticus.
- H. An Artery which comes from the Ramus Celiacus to the hollow part of the Liver.
- I. A branch of this Artery, which enters the Liver.
- KK. Another branch of the same Artery which goes unto the Gall-bladder.
- L. A Nerve of the sixth pair which goes unto the Liver.
- M. A final Lap or Scollup stretched out unto the Call, by which the Liver being full of water, is sometimes emptied.
- NN. Certain Eminencies of the Liver, anciently termed Portæ the Gates.
- a. The bottom of the Gall-bladder, hanging without the Liver.
- d. The common Channel, made up by the passages of Ramus Hepaticus.



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FIG. II. Shews the Vessels of the Liver freed from the Parenchyma or Flethy Substance thereof, with the Gall-bladder.

- AA. A portion of Vena Cava.
- BB. A portion of the Trunk of Vena Portæ, passing forth of the Liver.
- CC. The Gall-bladder.
- DD. The Navil-Vein ending into a branch of Vena Portæ.
- EEEEEEE. The branches of Vena Portæ, dispersed through the whole Parenchyma of the Liver.
- FFFF. The branches of Vena Cava, especially those which are distributed through the upper parts of the Liver, and joyned in sundry places with the branches of Portæ.
- GGGG. The most remarkable Anastomoses or joyning together of the Mouths of Vena Cava and Portæ.
- HHHH. The extremities of the said Veins, called Capillary Veins, because of their smallness.
- a. The Meatus Cysticus or passage into the Gall-bladder.

a certain little lobe, of softer Flesh then the rest of the Liver, compassed with a thin and subtile Membrane, which is carried out into the Call, and sometimes empties the Liver when it is full of Blood. In this little and soft lobe, I have manifestly observed certain small

Veins inserted in the cutting up of Fishes; so that according to the diversity of the parts of the Liver, we have now the Insertion of these Vessels which hath hitherto been unobserved. But in Beasts (excepting Ox and some others) it is divided into di-

which they call *Lobes* of *Scollops*, wherewith they say the *Stomach* is covered and contained, as with so many fingers. *Galen* therefore and *Plempius* have done ill to say that *Mans Liver* is divided Naturally into *Lobes*, *Laps*, and *Scollops*, for preternaturally and rarely it is indeed so divided, as *Fernelius*, *Sylvius*, and *Gemma* have observed. *Galen* is to be excused, because he took the Extuberances of the *Liver* made of the *Trunks* of the *Vessels* for *Lobes*. And *Horslius junior* doth learnedly refute *Plempius*, for giving out the *Clefts*, *Cavities*, and *Extuberances* of the *Liver*, for *Lobes* perfectly distinct.

Its Magnitude. The Greatness and thickness thereof, is remarkable and exceeding great in a man (as is his *Brain*) not only for Nutrition as in brutes, but for the breeding of Animal Spirits, which are often dissipated (and they are bred of the *Vital Spirit*, as it is bred of *Blood*. Yet it is greater then ordinary in bodies that are of a cold Complexion, and in fearful Persons and great Eaters, to augment the Heat of the Heart. In persons dead of a Consumption, I have sometimes seen an exceeding great *Liver*, four or five times bigger then ordinary, and sometimes again very exceeding little. And others have found a very small *Liver*, and sometimes no *Liver*, or the *Liver* consumed away; and a great and strong Spleen performing its Office. *Rhassus* and *Abernethy* gather the greatness of the *Liver* from the length of a bodys fingers.

Its Membrane. It is compassed with a thin Membrane, springing from one of the Membranes of the *Veins*, which hath its Original from the *Peritonæum*. In this there arise little bladders of water, from whence the *Droppie* come. Witness *Platerius*. I have seen of these bladders in the *Goat*, many in number, whitish, which being cut open, were found to contain within a single coat or skin, wherewith Humors, with stony *Flegm*, and another yellow substance, whether through a fault in Nature, or because the *Goat* was tamed. I have more then once found interwisted ropes of *Worms*, in other Membranes of the *Liver*.

Its Connexion. It is fastned by three strong Ligaments. 1. To the *Belly*, by the umbelical *Vena*, or *Navil-vein*, which after the Birth, is in grown Persons dried up, and turns to a Ligament, lest the *Midriff* should dangle too much, and should hang too low down. 2. Above to the *Midriff*, on the right side, by a broad membranous and thin Ligament, but yet a strong one arising from the *Peritonæum*, which the *Midriff* undercircles; and this is called the *Ligamentum suspensorium* or hanging Ligament. 3. Also above to the *Diaphragma*, but on the left hand, by another Ligament sprung from the *Peritonæum*, round, and exceeding strong: Also in its after-part where the *Vena cava* passes, it cleaves by its buncy side to the *Peritonæum*. *Riolanus* reckons these three Ligaments for one, because he contends that the umbelical *Vein* is dried up, which being carried through a duplicature or folding of the *Peritonæum*, hath for its Companion the Membrane it self, which being rouled back over the *Liver*, runs out upwards & downwards to the *Diaphragma* it self, which it invests and fastens. But it is al one case. For Ligaments are termed sundry, because they fasten and suspend divers parts of the *Liver*, although the two latter arise from the *Peritonæum*. Now therefore according to his reckoning, there will be two Ligaments, not one only; the former from the Umbelical, and the other from the *Peritonæum*.

The fourth Ligament annexed to the *inferiorem*

Cartilago, at the Cleft of the *Liver*, is no peculiar one, but must be reckoned as part of our second Ligament.

It hath a Substance red and soft [so] Its Substance that with a little stick it may be beaten off, and separated from the *Vessels* interwoven, either when it is boyled or being raw] spread about the *Vessels*, like congealed blood, for which cause it is termed *Parenchyma*, that is to say an Effusion or shedding forth of blood, because it is poured about the *Vessels*, and fills the spaces between them [in some kind of fishes it seems to be a congealed Fat; out of which an Oyl is boyled to burn in Lamps. Yet is it hardly corrupted; for *Riolanus* hath observed that a *Liver* having been accidentally kept a year together, hath remained uncorrupt. In substance it is most like an *Oxes Liver*, and being boyled, differs not therefrom, neither in consistence, color, nor taste, and therefore our flesh is more like that of *Oxen* then of *Swine*.

The Color of a sound *Liver* is ruddie [but] Its Color if it be quite void of blood; or boyled, we may rightly say with *Gordonius*, that it is whitish, as is an Embryo, before effusion of blood be made. But we shall find it very large and red, in Children new born, of a good Constitution. I have demonstrated it to be yellow, in the fish called a Lump. In a Lamprey it is green (which makes *Bronzerus* dispute touching the Principallity of the *Liver*) though the blood be red; whether it have contracted its color here, or in the Heart, or from it self. In some sick persons, as those which have the *Droppie*, it is very pale, as also the *Spleen* and *Kidneys*.

Now those *Vessels* in the *Liver*, are the [its Vessels. Roots of *Vena porta* and *cava*, (with a few] [to a mans first thinking, but upon serious Examination according to the Observation of *Waleus*, an innumerable company of] small Arteries interposed, of a whiter color, dispersed from the *Cœliaca*, through the saddle part thereof) [partly that they might nourish the *Liver*, and warm it thoroughly with the heat of the heart the branches of *Vena porta* assisting likewise to the same intent; partly that by the motion of the Pulse, and the necessity of running back, it may assist and provoke the passage of the blood out of the *Liver* according to the conjecture of *Stegelius*. For whereas *Galen* tells us that the *Liver* is cooled by the Arteries, that is not consonant to truth: For they are hot, and by their motion further the blood, and draw it to those parts wherein they are implanted;] which appear distinct, the flesh or *Parenchyma* of the *Liver* being taken away, how they are carried this way and that way, without order, among which also small branches are disseminated, which afterwards unite into one common Passage, and so carry *Choler* into the *Gall-bladder*. Now it is conjoynd with the *Roots of Porta*, that there the Blood may be separated from the *Choler*. But more *Roots* of the *Porta* are spread up and down here and there through the lower part of the *Liver*, very few through the upper part: Contrariwise, more of the *Roots* of the *Cava* are carried through the upper and tuberos, or bossie part thereof, and fewer through the hollow or saddle part. To these must be added the *Roots* of the *Milkie Veins*. *Affellius* did sometimes observe their trunk to be in the *Liver*. But he did not precisely add the place, which I have determined to be in the third Lobe.

The *Anastomoses* or Conjunctions of Their Anastomoses the *Roots of Vena Porta* and *Vena Cava*, *Stomoses* are peculiarly to be observed. For rejecting those who altogether deny the Union of these

Veins,

Veins, or who conceive that they are obscurely and hardly known: [among whom *Hieronymus* and *Riolanus* are lately come upon the stage, the former of whom could not find any Anatomies, either in the Liver, Spleen, or any other Bowel.] Though they had been boyled, till the whole *Parenchyma* would crumble in peices, and was separated like dust from all the strings of the Vessels, with a needle. Only he observed this one thing, in a fresh Liver, viz. that all the branches of *Vena Cava* creeping along the bossie part of the Liver, have Coats like *serices* full of infinite little holes, as being made for the draught of the Body, to receive such Blood as settles there: but that the branches of the *Vena Porta* are not so but are divided into boughes, and that every where the branches of both, do run out to the highest Eminency of the bossie side of the Bowel, without Anatomies. But the *Porta* hath likewise very many holes great and little, as the *Cava* hath, some of which will admit the probe, others not, only they make certain Cavities covered with a thin Membrane. Whence it is apparent, that the blood is staid by those closed holes, and not strained out, some of them being covered with a Coat, *Riolanus* inspired by the same Spirit, doth strongly oppose the Anatomies of the *Vena Cava* and *Porta*: least he should be forced to admit the Circulation of the Blood in that Place. He was afraid that the concocted liquor should be confounded and mixt with the unconcocted. And what if they be, confounded and jumbled together? The Chymus being changed into imperfect blood is confounded coming out of the milky Veins, with that which is contained in the *Cava*, for both of them are to be perfected in the Heart. And the other which flows out of *Porta*, prepares both with its acid juice. But be it how it will be, the Authority of all Anatomists doth assert those Anatomies from the times of *Erasistratus* and *Galen* to our daies, because it is manifest to such as search diligently, that these roots are joyned together, sometimes atwart, so that one lies over the middle of another as it were, sometimes the extremities of one Vein touch the Extremities or ends of another, otherwhiles the ends of one touch the middle of the other; and sometimes they touch not one another at all; peradventure where the Branches of the Liver serve only for Nutrition. *Baubin* wishes us chiefly to observe a remarkable Anatomy, which resembles a channel, and is as it were a common and continued passage, out of the Roots of *Porta* into the Roots of *Cava*, admitting a pretty big Probe. But because we cannot rely upon naked Authorities, experience must be called by us to counsel, which doth necessarily perswade us that there are such Anatomies or Unions of the Mouths of the Vessels, by reason of the passage of the Blood out of the milky Veins and the *Venæ Portæ*, unto the *Cava*, and out of the manifest Arteries, seeing the passage only through the flesh cannot suffice, in a quick and plentiful Flux. I confess all the kinds of Anatomies are not apparent to the Eye as to be seen open, in dead bodies, though no man can therefore deny that there are such things; but some of them are insensible, which admit neither Probe nor Wind, and some admit Wind and nothing else. The Renowned *Walsley* observed and found by experience, that the Veins of the *Porta* are in the Liver no where opened into the greater branch of *Vena Cava*, but that the very smallest branches of *Vena Porta*, do open into the smallest branches of the *Vena Cava*, as he observed in a Liver blown up with wind, after the flesh was taken away, and floating upon water. I have in an Oxes Liver curiously sought

for apparent Anatomies, because there they must needs be visible because of the greatness, following the example of the most learned *Stegellus*. But the very truth is they are not visible to the Eye: the Vessels indeed are divers waies interwoven and twisted one among another; Trunk with Trunk, branches of the Trunkes, either with the Trunk of another Vein, or with little branches; and that either in the middle of those little branches, or in the extremities, even as we see both the Vessels cleave together in the Womb-cake: But a Probe finds no entrance, by any open hole of an Anatomy. Nevertheless, it is not to be denied, but that in living Bodies there is a passage known to Nature though unknown to us by reason of the necessity of a through passage. Which I the rather believe, because that in the conjunction of the Vessels, yea even of the greater, where the Anatomies seems shut, the Coat is extraordinary thin and for the most part single, as appears by its transparency; which in Living Bodies being rarified by heat and motion, doth easily suffer the blood to pass through.

By these Unions therefore of the Roots of the *Vena Cava* and the *Vena Portæ*, the Blood may pass through: And by them likewise the peccant matter passes, when we Evacuate the habit of the Body by Purgations. Not that it should be carried out of the *Porta* to the Mesentery, as hath been hitherto beleived, but so as thence to pass through the Heart, and be emptied out through the Celiacal Arteries, and thence through the stomach or the Gall-Conduits into the Guts, forced along by virtue of the purging Medicament.

Those Anatomies are likewise to be observed, by which the smal Veins of the Gall-bladder, are joyned to the Branches of *Vena Portæ* and *Vena Cava*.

The Roots of *Vena Portæ*, do by little and little towards the lower part become smaller and greater, until they make one Trunk, which is called *Vena Porta*, the Gate-Vein: So also the Roots of the *Cava*, above and in the fore-part do altogether make up one Trunk; before the going out whereof, certain Circles are placed, here and there in the greater branches, being of a Membranous substance and very like to Valves, sometimes thicker, other whiles thinner and like Cobwebs, which were first discovered by *Stephanus*, and after by *Conringius* in an Oxes Liver; and I likewise found them, looking towards the larger trunk, which hinder the return of blood, not so much of that which is impure and dreggy, as of the pair being once gone out to the Heart; afterwards, as soon as it comes to the Liver, it is divided into two great branches, the ascendent and descendent; and hence it is that they say, the *Cava* arises from the upper or bossie part of the Liver, and the *Vena Portæ* from the lower and hollow part.

The Liver hath two Nerves from the sixth pair, one from the Stomach, another from the Costal, dispersed only through its Coat, and not through its substance (as *Vesalius* will have it) that in its inmost body, it may be void of sense, in regard of so many motions of humors. And therefore the pains in this part are dull and rather a kind of Heavyness then pain. Yet *Riolanus* hath observed, that two remarkable little Nerves do accompany the *Vena Portæ*, and go into the very substance of the Liver.

The Action of the Liver is Sanguification. For of the Chylus drawn by the Mesaraick milky veins, the Liver makes Blood; and the Blood is made

The Original of the Veins.

The place of Blood-making, the Matter and Effluvia.

The Explication of the FIGURE.

This TABLE shews both sides of the Liver and the Gall-bladder,
Distinct one from another.

The XVII. TABLE.

FIG. I.

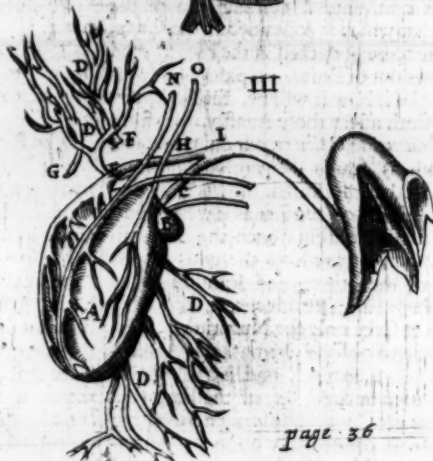
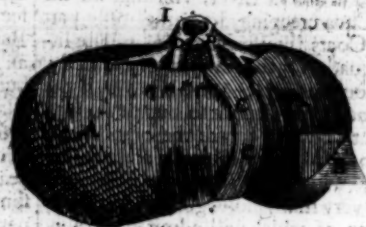
- AA. The Convexe or Bessie side of the Liver.
- B. The Liver's Membrane Separated.
- CC. The Ligament of the Liver called Septale.
- DD. The coming forth of Vena Cava, out of the upper part of the Liver.

FIG. II.

- AA. The concave part of the Liver turned up.
- B. A Lobe or Scollup of the Liver to which the Gall joynes.
- C. A cleft of the Liver, out of which the Navil-Vein D. descends.
- E. The Gall-bladder.
- F. The Gall-bladder Channel.
- GG. The Choler-passage, ending into the Duodenum H.
- I. The trunk of Vena Porta descending from the Liver.
- K. The Right-hand Celiacal Artery.
- L. A Nerve brought unto the Liver.

FIG. III.

- A. The bottom of the Gall-bladder.
- B. A Cavity at the rise of the Neck of the Gall-bladder.
- C. The Neck of the Gall-bladder.
- DD. The Passage of the Gall-bladder between the roots of the Vena Porta F. and of the Cavae G. dispersed through the substance of the Liver.
- E. The concurrence of the passages of the Gall-bladder.
- H. The Porus Biliaris or Choler-pipe, broader then the Neck of the Gall-bladder.
- I. The common passage of the Choler-pipe and Neck of the Gall-bladder.
- K. The Orifice of the Choler-passage, in the Gut Duodenum.
- I.M. The Gut Duodenum opened.
- N. An Artery dispersed into the Liver.
- O. A final Nerve of the Liver and of the Heart of the Gall-bladder: which the graver hath represented too large.



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in the branches of the milkie veins; the substance of the Liver, doth not only sustaine the Veins, as some would have it, but it is the efficient of Sanguification: And together with Blood, it generates natural Spirit.

The Authors
opinion how the
blood is made.

Sanguification therefore or Blood-making, is thus performed: the more unprofitable and thicker part of the Chyle (which is made first in the Stomach and finally perfected in the thin Guts) is thrown out into the thick Guts, and voided at the Fundament; but the more laudable and thin part, is drawn in by the milky veins, spread up and down in the Guts; and a little altered, and from them by means of a power proceeding from the Liver, it receives the first Rudiments of Blood, and is then called

Chylus. The greatest question is whether the Liver draws it, or it is forced thither. It seems to be drawn by the heat of the Liver, as Chaf or Straw is drawn by heated Amber, and as Blood is drawn into the outward parts by hot Fomentations. Which is here visible by Ligatures and live dissections, in which the attraction of the Liver is so great, that the milky Veins are speedily emptied. There is not the same necessity, that it should be forced thither, as others have thought, because the beginning of the Motion or moving principle should either be without the Chylus, or within it. It cannot be in it. 1. Because nothing thrusts or drives, but that which is alive. 2. The Chyle newly drawn out of the Vessels, doth not move itself. 3. It is void of Appetite. 4. It should alwaies be driven downwards, not up to the Liver. Nor can it be in any

any thing without it. 1. Because the Meſeraick Arteries have enough to do to drive out their own blood, and the Veins have work enough to receive it. 2. And the milky Veins are exceeding ſmall. 3. The proper Fibres of the Veins, do ſerve more for ſtrength, than for driving. 4. The Stomach indeed, and the Guts are contracted, but they are not able to expel the chyle; for their motion is obſcure, and though it were evident, yet it would not preſently follow, that it muſt drive into the Liver. 5. Thoſe Bowels being contracted on all ſides, and ſhut up, as much Chyle is retained, as is expelled. 6. The Abdomen doth oftentimes reſt, according to our deſire and pleaſure, being apt to be moved by the Muſcles; but the motion of the Chylus is performed continually and ſwifly, viz. the due time of diſtribution being come. 7. The dreggy Chyle ſhould be ſent unto the Liver, without difference, as well as the pure. It is therefore principally drawn by the Liver, howbeit ſome conſtruction of the Guts, is ſecondarily aſſiſtant thereunto. This Chymus being attracted in the Roots of the milky veins, as in the place where, is by the Parenchyma or Subſtance of the Liver, as the Efficient cauſe, with the aſſiſtance of the internal heat of the Chyle, changed into a new ſubſtance of blood. Now it gains a Redneſs like the ſubſtance of the Liver, not ſo much from the fleſh of the Liver alone, which it ſelf owes its color to blood ſhed about it, which it lays away when it is waſhed or boyled, and in ſome other Creatures we find it of a green color, as from its own proper and adventitious Heat (as Grapes are red) which vaniſhing away, the redneſs ceaſes, as it happens in blood-letting. Nor is that a ſufficient cauſe, ſeeing in healthy bodies it continues afterwards red, and therefore we muſt take in light as another Cauſe, of which there is a great quantity in red colors, ſubſiſting even without Heat, unleſs the ſubject happening to be diſſolved, it come to be extinguished and exhale. Hence it is, that boyled blood becomes black, and putrid blood is duſkie. Hence alſo, by how much the more Natural inbred light any man hath, the more he ſhines with bright blood; contrariwiſe, in Melancholick perſons, the ſame being darkned, the blood grows black and dark. That light and fire are the cauſe hereof appears in Oyl of Sulphur, by the mixture whereof Liquors become red.

Now this Heat and Light, is partly planted in the liver, and the Chyle it ſelf, ſpringing thereout, by reaſon of its previous preparation, and partly kindled therein, either by reaſon of the nearneſs of the Heart, and bordering parts, or by reaſon of the Arterial blood, derived from the Heart and Spleen.

The more crude Blood being thus made, is not diſtributed to nourish the Liver or the Body, which Office is performed by the Hepatick Arteries, but by inſenſible Anaſtomoses of the fleſh and Veſſels, it is expelled into the Roots of *Vena cava*, where by longer tarriance, it is more elaborated, and ſoon after with the returning blood of the *Vena porta* and the Arteries, it is poured out into the Trunk of *cava*, going all ſtraight along, through the upper part of the Trunk to the heart, that it may there attain its laſt accompliſhment where-by it becomes fit to nourish all the Parts. Not any thing returns this way to the Liver, the Valves hindering, which in the Liver look outwards, in the Heart inwards, as the whole Fabrick and Ligatures do teſtifie. By theſe it is, that the *Cava* alwayes ſwells towards the Liver, and is empty towards the Heart.

Afterwards the Nouriſhment of all the Parts of the Body being accompliſhed by the Capillary Arteries, becauſe all the blood is not conſumed, which by conti-

nual Pulſations is ſent forth, nor can that which is ſuperfluous return the ſame way, by reaſon of the Valves of the Heart ſeated by the Aorta, which lets any thing paſs from the Heart, but admits nothing back again; and becauſe any Artery being tied, is full, and ſwells towards the Heart, but is empty, and lank towards the Veins: Therefore it muſt needs return as it were by a circular motion, out of the ſmalleſt Veſſels back again into the greateſt Veins, and the Trunk it ſelf of the *Cava*, and thence into the Heart. As it paſſes through the Liver, other blood there newly bred, is joyned with that of the *Vena porta*, and that which is redundant from the Arteries, for the reſtoring of that which is ſpent, and ſo the Circulation is again repeated. Mean while, as hath been ſaid, Choler is drawn out of the blood, by branches of veſſels, terminating into the Gall-bladder and Choler-paſſage. But the wheyiſh part, is becauſe of its thinneſs retained a while, that the blood may more eaſily paſs every where, and afterwards it is ſent away, partly to the Kidneys (with the wheyiſh blood, which according to *Galen* is not concocted in the Kidneys, but becauſe the Serum is an Excrement of the Liver, the Kidneys do only ſeparate the blood from the whey) and from thence by the Ureters into the Bladder; whence the Urin does afterward partly go into the Skin, and paſſes out by ſweat and inſenſible Tranſpiration.

CHAP. XV.

Of the Receptacles of Choler, viz. the Gall-bladder, and Choler-paſſage.

ON the right hand and hollow part of the Liver, for the Reception of two ſorts of Choler, thick and thin, two Conduits or Paſſages are engraven: The *Veſica biliaria* or Choler-bladder, and the *Canalis biliaris* or Choler-channel. *Galen* himſelf knew as much, when he ſaid that from the Liver a twofold cholerick Excrement was purged: the one unmixed and ſimple, the other mixed and thick, which I collect contrary to what *Hofmann* aſſerts, out of the fourth Book of the Uſe of the Parts, 12. and 13. and from the fifth Book Chap. the 6. For the Channel poures out thick and dreggy choler, but the Bladder ſuch as is more thin and yellow. For the latter bordering upon the *Vena porta*, ſucks more plentifully out of the Spirituous and Arterial Blood; the former being placed at the Roots of the *Cava*, draws a leſs quantity of Choler, and ſuch as is more thick, becauſe that blood is thicker.

The *Veſica biliaria* or Gall-bladder called alſo *folliculus Fellicus*, is a Veſſel long and round, fashioned like a Pear, hollow, furniſhed with a double Membrane, the one, whereby it is faſtned to the Liver, from the Peritonæum [which is alſo the ſame, wherewith the Liver is covered] without Fibres, and wherewith that part only is covered, which hangs without the Liver: The other proper and more thick, but ſtrong, having all manner of Fibres; which a certain Cruſt encompasses, bred of the Excrements of its third Digeltion, to keep off the ſharpeſs of the Gall.

This Gall-bladder is ſmall, compared to the Spleen and Kidneys. Being two

See Fig. III.
Table 17.

The Shape of
the Gall-bladder.

fingers

fingers breadths in deepness : but the more cholerick any person is, the greater is this Gall-bladder observed to be.

Division. Tis divided into the Bottom and the Neck.

Bottom. The Bottom is round, and seated lowermost, viz. when the Liver is in its Natural Situation, it is dield with a yellow color, and sometimes black, viz. when the Choler being over long kept, is burned.

Neck. The Neck, being harder then the bottom, looks upward, grows long and narrow, until it end into a very small and narrow passage. At the Neck is observed, first a certain peculiar hollownes, and also certain little Valves or Membranes, sometimes two, otherwhiles three, which hinder the Regress of Choler. *Regius* proves, that they are sometimes opened by Spirits, through a Nerve inserted into the liver, and so let Choler return into the Liver; which appears by anger, and the sudden boyling of the blood in angry persons, by admixtion of burnt Choler. Howbeit by pressing, or squeezing, and blowing, we cannot force any Choler back. And if the force of the Spirits were so great, they might as easily open and shut the valves of the Heart, when they are in the Arteries more plentiful then ordinary. They pierce indeed by their fineness the valves, when they are shut, but they carry not the blood with them. Choler, truly, may by some other means be inflamed, which is every where among hot blood. Finally, the valve would be broken by the violence of Spirits, and greater danger might follow thereby, then if the Gall-bladder were broken, an Example whereof *Salmuth* relates.

The Gall-bladder hath received very many small Passages, furnished with sundry little twigs, sowed up and down in the Liver, between the Roots of *Cava* and *Porta*; which afterwards being joyned into one passage, do carry pure Choler into the Gall-bladder: and the Gall-bladder having disgorged it self into the Gut, is daily filled again, and so it continues that course. Contrary to the Opinion of *Arniseus*; that the Bladder is filled with Choler, which being hindered by the Chylus, from descending by the *Porus biliaris*, into the Guts, does drive back again into the Bladder. For I have often seen *Walens* demonstrate, how that the Bladder being never so little squeezed with a mans hand, even when the Guts are full of Chyle, Choler is easily squirted into the Guts.

Its Veins and Arteries. It hath two very small Veins to nourish it. Also it hath very small Arteries from the *Cœliaca*, to nourish and preserve Heat. It is not therefore nourished with Choler, as *Joubertus* conceives. It hath a little diminutive Nerve, scarce visible, from a little Branch of the sixth pare, which crawls up and down the Coat of the Liver.

Its Use. Its use is to receive yellow excrementitious Choler, pure and thin (not the Excrement mingled with the Blood, as the Kidneys do) and to retain it some while, and then to expel it.

Now touching the use of this Choler, Learned men are of sundry minds. Some with *Aristotle* will allow it no use, only it was a thing could not be avoided, and is drawn away, that the Blood may not be defiled; which Opinion *Conringius* maintains. Others attribute more to Choler, and make it useful to the whole Body. I. In that it is in the Liver, according to *Italy-Abbas* and *insina*, and by that means comforts the second Digestion, and helps the Natural Heat of

the Liver, like fire under a kettle. Yea, it heats the whole Body, if we will credit *Nemesius*, especially the Stomach, to further its Digestion. If that be true, we must understand it of a moderate quantity thereof; otherwise an over great Heat of Choler would burn the Stomach.

2. Of kin to these, is the Opinion of *Helmont*; that it is the balsom of the Liver, and the whole Blood, brought from the Liver to the Mesentery, and that therefore the Gall precedes in the work of Sanguification, and the Liver follows also he says it hath the constitution of a necessary Bowel. But how should it come into the Liver, since Anatomy doth teach, that this humor is brought out of the Liver, but not carried back thither. For, the way is too long, through the Mesentery, where by reason of its acrimony, it makes haft out, or the edge thereof is blunted. And of what shall it be bred, if it go before the Concoction of Blood? There are few Veins and Arteries dispersed thereabouts, but store of Choler is collected. That the Action of the Liver goes before that of the Gall; Children in the Womb do shew, in whom the Liver is full of blood, before the Bladder swell with Gall, or be so much as lightly colored therewith.

3. Their Opinion is not much unlike, who conceive that Choler preserves the neighbouring Parts, and the Liver it self from corruption, which *Zebus* would therefore prove, because when the Gall-bladder is removed from the Liver, the substance thereof where the Gall-bladder lay, does presently dissolve and melt.

4. A greater number of Authors will have it to serve to expel the Excrements of the Belly, by strengthening the Guts with its Heat, or provoking them to Expulsion by its Acrimony. For although the Choler-passage, be implanted into the beginning of the Gut Jejunum, or into the Duodenum; yet it hath an easie passage to the Colon and Ileum. That it passes through the Jejunum, is manifest from its yellow color, and the quick passage of the Chyle there through. Howbeit, it ought to be moderate in quantity, otherwise the Belly is dried and made costive, or too much loosened.

5. I add, that it makes the Dung liquid, and apt to pass, to which intent Painters use it to temper their colors.

The other Receptacle of Choler, is *Porus biliaris*, the *Canalis* or *Porus biliaris*, the Choler-passage, which is found even in those Animals which have no Gall-bladder, as the Hart, the Deer, the Camel, the Roe, the Dolphin, the Sea-calf, &c. It is a vessel round and long, and the passage thereof is twice as large as the Neck of the Gall-bladder, and it goes right out from the Liver [being sometimes forked, yet so that its two branches do soon become one, according to the Observation of *Riolanus*] through the common passage into the Gut (not into the Gall-bladder, as *Fallopins* conceived) receiving a thick cholerick excrement, which may plainly be perceived, if the said passage be opened and blown up, for then the Gut swells, and not the Gall-bladder. And *Riolanus* observed that some have died of a Dysentery proceeding from Choler, in whom the Neck of the Gall-bladder was obstructed, but the *Porus biliaris* or Choler-passage, very much enlarged. Which also was known to *Galen*, who will have Choler to be forced right forwards, even from the Liver into the Gut Duodenum: And next to *Galen* we are beholden to *Fallopins* for the true Description of this Choler-passage.

The *Ductus communis* or common Passage, which goes into the *Ductus communis*, the *canalis naturalis*, the common passage natural, beginning of the Gut Jejunum, or mon passage natural,

about the end of Duodenum, is made up of the Necks of the Choler-passage, and of the Gall-bladder, and is obliquely inserted between the two Coats of the Gut, the length of a finger, and sometimes it is parted into two, having loose Membranes, from the inmost and middle Coat of the Guts, before its Orifice. Where there is plenty of Choler, as in cholerick Natures, it often flows back into the Stomach, so that such persons fasting, are often griped in their Bellies.

Presernatural. Sometimes though seldom, this Passage goes into the bottom of the Stomach, and there empties Choler. Whence proceeds Vomiting of Choler, and such persons are termed *Picrocholoi ano*, Choler-vomiters. Which is seldom found in ravenous Beasts, according to the Observation of *Argentarius*; as also in Dogs by the Observation of *Waleus*, contrary to the Opinion of *Akakia*. But in case this passage be inserted into the end of the Gut Jejunum, such persons are ever troubled with cholerick Loosnesses, and are termed *Picrocholoi nato*, Choler-purgers by stool. Such as he must needs have been, in whom the Choler-passage was inserted into the Gut Colon, as *Severinus* observed, when he dissected the said party at Naples.

Chap. XVI. Of the Spleen.

Situation of the Spleen. **L**iver or Spleen the Spleen, is seated under the short Ribs on the left side, just over against the Liver, as if it were a second Liver, under the Midriff, between the Ribs and the Stomach, being in some higher or lower than in others. Yet in all it is nearer to the hinder or back-part, seeing it rests upon the Vertebrae and the bastard Ribs, so that a man cannot feel it with his hand, unless it swell, and so become nearer to the Belly-rim; and this situation of the Spleen is seldom so changed, as to find the Liver in the left side, and the Spleen on the right.

Its Number. It is for the most part only one, seldom two (as *Aristotle* observes in the 4. de Generatione Animalium, Chap. 4. And *Petrus* at Montpellier and *Panarolus* at Rome) and more rarely three one upon another, though not all of like bigness (as *Fallopis* observed) but a most rare case it is for the Spleen to be wanting (as *Aristotle* hath observed in the place forecited, and also *Laurentius* and *Schenkius* concerning one *Matthias Ortelius*, and *Hollerius* in a certain Girl) nor can it naturally be wanting, because Nature abounds not in things superfluous, nor is wanting in things necessary. That vulgar

Whether the Spleen may be taken out of the Body. Opinion is therefore fabulous, which holds that it may be taken out of the Body without danger of death, and that in such as used to run Races, it was usually taken out, which never any man yet saw or recorded, excepting *Pliny*, *Flud*, *Fiorovanta*, *Rouffetus*, who if they speak truth, doubtless those persons made a very bad shift to live, or died soon after, for want of that most noble Bowel, or only the outward part of their Spleen was cut off. For deep Wounds in the Spleen are to be accounted mortal, because of the plenty of Arteries, and the consent it hath with the principal Parts of the Body. This Conceit sprung Questionless from that old Opinion of *Erasistratus*, who conceived that Nature had made the Spleen in vain, which Opinion *Plautus* also follows in his Comedy

called the Merchant. And others follow them, who are so far to be born with, if they shall say it is not necessary in reference to all kinds of Live wights, but only in respect of some sorts. For such live Creatures as have no bladder do want a Spleen without detriment, as the Chamæleon, and many others. Insects have no Spleen, and therefore that Proverbial Speech is false: *Habet & musca splenem, even a Flea hath a Spleen.*

It is not so great as the Liver, yet in Mankind the Spleen is sufficiently thick and big, not so much because of the stubborn humor which it is to master, and is hard to overcome, as because of the Arterial, fermentative, or leavening, and yeasty Blood, which it was to contain. For it is six fingers long very near, three fingers broad, one finger thick, of which greatness it is not found in any other living Creature. Yet is its bigness various, according to the variety of Subjects, and the several Constitutions of Men. 'Tis thought to be larger in such persons, as have Naturally a greater quantity of Melancholy or acid Juyce than others have, which flowing thercunto, it is soon augmented by reason of its loose and spongie substance. Those persons whose Spleen is over grown, are lean, and bad colored. Whence it was that the Emperor *Trajan* termed the Exchequer a Spleen, because as the Princes Exchequer is enriched, the People are impoverished; so as the Spleen increases, the Body pines. They who conceive it elaborates the Chylus, do bring this for a reason, viz. that it draws too much Chyle by the *Ramus splenicus*, and defrauds the Liver. But because that Action of the Spleen is questioned, another reason must be sought after. The most renowned *Comringius* allows the Premises for true in a præternatural greatness of the Spleen, otherwise, if it be Natural and legitimate, the Body flourishes when the spleen does flourish.

Be the state of the Spleen what it will, I conceive the Body is diminished, when the Spleen is augmented, because it bereaves the rest of the Body of the fermentative acid Juyce, and either consumes it to nourish it self, if it be naturally great; or is unable to prepare and expel it, when its greatness is præternatural and sickly.

Its Shape. Its Shape is for the most part like on Oxes tongue, whence some have called it *linguiformis Viscus*, the Tongue-bowel. On the outside towards the Ribs and the Midriff, it is a little bunching and bossie; sometimes it hath marks made in it by the Ribs, being hollow on that side, which is towards the right hand, by reason of the stomach which lies close by it: Where all along the middle part, there is a certain white Line, with prominencies in it, which admits Veins and Arteries with the Caul. Howbeit, præternaturally it receives sundry Figures, viz. exactly round, triangular, sharp-pointed, made rough with eminencies, divided into two parts; as *Archangelus* hath rightly observed.

Its Color. Its Color in a Child in the Womb is red, like that of the Liver, because it is nourished with pure Mothers Blood: But in persons come to age, it is blackish, because of the thick blood wherewith it is nourished, and in such as are yet older, it becomes black and blew. I have observed it red in grown persons, and *Vesalius* before me, as also *Spigelius* who therefore beleives, that such as have it blackish are unhealthy. *Comringius* thinks that black color is caused by Intemperance in eating, and in drinking especially. I do attribute much to the temper of particular persons in this case, and to the variety of Heat. Now the Spleen does præternaturally put on many colors, according

Why a man hath a large Spleen.

cording to the Humor predominant, as black and blew, ash-color, &c. In Beasts of hot Constitution, it is blacker then in Mankind, and in Swine it is whiter.

Connexion. It is knit by thin Membranes arising from the Peritonæum, to the Peritonæum it self, the Gall, and the left Kidney, sometimes also to the Septum, which *Fernelius* denies, nor can he be excused, unless we shall say he intended the Centre of the Midriff, for thereto it is not fastned. But in its hollow part, it is knit to the upper Membrane of the Caul, from which also (according to others from the Peritonæum, or as some will have it, proper to it self) it receives,

Its Coat. A Coat thin and single, yet thicker then the Membrane of the Liver, which in aged persons is oftentimes hardened, so as to become bony and grifly. It ought to be thicker, that it might be stronger to endure the force of the Arterial Blood.

Substance. Its Substance or Parenchyma, is like thick, black, and congealed blood. It hath Vessels of all kinds.

Its Veins. It hath from the *Vena Porta* a remarkable Trunk, which is called *Ramus splenicus*, scituate far beneath the Liver, and sent athwart unto the Spleen. The numerous branches of this bough, being for the most part small as Fibres, are spent in the Spleen, saving two which sometimes pass out of the Spleen: The one is called *Vas breve* entering into the stomach, sometimes by one, otherwhiles by more branches [which more frequently, as *Waleus* informs us, is a little branch of *Vena splenica*, which when it is come to the middle space betwixt the stomach and the Spleen, it is divided forkwise into two twigs, one of which goes to the Spleen, the other to the stomach] which vessel some will have to belch out acid blood to provoke appetite, or to strengthen the stomach, which is afterwards voided by the Guts. Another branch goes unto the Fundament, and makes the internal Hemorrhoid Veins.

Its Arteries. It hath many and great Arteries from a branch of the *Cœliaca*, which the Liver hath not. 1. To cherish life and inbred heat. 2. That the Blood might be more strongly altered. 3. That for its own Nourishment, it might receive blood, and withal prepare acid Juyce brought thereunto, with Arterial blood, for to ferment the Chyle and all the Blood.

Its Anastomoses. Now we are to take special notice of the frequent Anastomoses of the Arteries of the Spleen, with the Veins thereof, especially one remarkable one, before the Entrance of the Vessels into the Spleen: the rest are in the Spleen.

Also we must observe its little Nerves, arising from the left Costal branch of the sixth pære, disperfed rather through the Coat, then the Substance thereof.

The Action of the Spleen is by such Doctors as follow the old Opinion said to be chiefly threefold. 1. To draw melancholick, excrementitious, and slimy Humors out of the Liver. 2. To separate the melancholick Excrement therefrom, that it may be nourished by the good blood. 3. To void it being separated, into the Stomach and Guts. Also they say that the nutriment of the Spleen is elaborated and broken by the Arteries, because spongy and loose flesh, ought to be nourished with vaporous and subtil blood. The Passages by which the melancholy Juyce is said to be belched forth, are first the *Vas breve*; and then the Hemorrhoidal Vein. They will have the Spleen therefore to

be the Receptacle of the melancholick Excrement, or of thick dreggie Blood separated in the Liver (even as the Gall-bladder receives the yellow Choler) and that therefore the Spleen is set just over against the Liver.

Howbeit I deny that the Spleen is ordained only to receive an Excrement; For

1. In the Spleen there is no large cavity receiving, as in the Gall-bladder, and in the membranous hollownes of the Kidneys, and in the Bladder.

2. If it were a Receptacle for Excrements, why was it not seated in an inferior place, that it might more conveniently receive the weighty Excrement as other Receptacles?

3. *Rondeletius* denying that the spleen is the Receptacle of Melancholy, gives this reason: because that humor while it is naturally disposed, is all consumed upon the bony, and other hard and dry parts; and seeing it is in us the least in quantity of all humors therefore there is no part ordained to receive it, no more then there is for bloody Excrements, which pass away by Sweat and insensible Transpiration. Yet I conceive this Argument is not very strong.

4. Why are there no Branches of this Receptacle spread through the substance of the Liver, or at least of the *Ramus splenicus*, even as the Gall-bladder receives Branches spread up and down the Liver?

5. Why are there not some Passages, which carry this Juyce from the Liver.

6. No part is nourished with an Excrement, notwithstanding the Saying of *Columbus*, that no part is nourished with an Excrement saving the Spleen.

7. It is absurd that an Excrement should flow back into the *Vena porta*, and afterwards into the *Ramus splenicus*.

8. It should receive in, and purge forth Excrements, by the same Passages.

9. The strongest reason, that the Spleen is no Receptacle of Melancholy is, In as much as it is another Organ of Sanguification, as shall be proved by and by.

Later Anatomists have conceived, that the Spleen doth elaborate Blood, as the Liver doth, but they are not agreed, touching the way, nor the Nature of the Chyle. *Casparus Bartholinus* my Father was of Opinion, that the Spleen did make a thick, but good sort of Blood, of the thicker part of the Chymus, which by an inbred Faculty it hath, it draws to it self, through the *Ramus splenicus*. This he proved,

1. By the likeness of the structure of the Spleen, with that of the Liver. For as the Liver is a fleshy Bowel, covered with a Coat, furnished with very many Vessels; the flesh whereof resembles blood, shed round about: Even so, the Spleen is a Bowel, furnished with a Coat, and with very many Vessels variously interwoven, whose proper flesh is as it were congealed blood, shed round about the Vessels.

2. In the Spleen, there are very many textures of the Vessels and infinite Anastomoses. Now there are no where such textures, and plications, or foldings of the Vessels, save for a new elaboration, as may be seen in the Brain, Liver, Stones, Duggs, &c.

3. It appears from the Scituation of the *Ramus splenicus*, which is far beneath the Liver, out of the Trunk of *Vena porta*, where part of the Chymus is attracted, or of the Chyle, which hath some disposition towards blood; If therefore it receives matter there, of which blood is made, why therefore shall not the Spleen make blood?

4. Nature

Whether the Spleen receive Melancholy from the Liver?

The argument of Rondeletius invalid.

Whether the Spleen make Blood?

4. Nature is wont either to double the Parts of the Body, and set one on each side, as appears in the Kidneys, Stones, Lungs, Duggs, Organs of the Senses, &c. or if she makes only one, she is wont to place it in the middle, as the Heart, Stomach, Womb, Bladder, Nose, Tongue, Mouth, &c. Therefore the Spleen must needs be another Liver.

5. Diseases of the Spleen, as well as of the Liver, do hurt Blood-making or Sanguification.

6. Sometimes the Situation of the Liver is changed, so that it is in the left side, and the Spleen on the right.

7. The Liver failing and growing less, the Spleen is augmented, and assists the Liver, as is known by many Examples, whence the Spleen hath been often seen in Dissections, to be greater and redder than the liver.

8. 'Tis unlikely that so many Arteries enter into the Spleen, for the sake of Excrements, but rather to digest & concoct thick Blood, that so by contrary thinness, the stubborn thinness of the said Blood may be overcome.

9. In a Child in the Womb, the Spleen is red as is the Liver, by reason of the cause aforesaid.

10. Such as the Diseases of the Liver are, such in a manner are those of the Spleen.

11. And the Diseases of the Spleen and Liver, are cured well near with the self same Remedies.

12. If Authorities are of force, enter *Aristotle* in the 3. Book of the Parts of living Creatures, Chap. 7. where he saith, that the Liver and Spleen are of a like Nature; also, that the Spleen is as it were an adulterate Liver, and where the Spleen is very little, there the Liver is Bipartite, or of two parts, and that all parts in the Body almost are double. *Plato* calls the Spleen an express image of the Liver. Others call it the Liver's Vicar, the left Liver, &c. The Author of the Book touching the use of Respiration, hath confirmed this, as also *Aporodisæus*, *Aræteus*, and others. *Archangelus* makes another use of the Spleen to be, to make more plenty of Blood.

For what Parts
the Spleen makes
Blood?

If any shall demand, To what end
serves the Blood which the Spleen makes?

Some conceive it serves to the
same end, with that of the liver, viz.
to nourish the whole body, and to

assist the liver.

But he was of Opinion, that this was not done save when necessity requires, in some defect or Disease of the Liver.

But he conceives that ordinarily the Spleen is an Organ to make blood, to nourish the Bowels of the lower Belly, as the Stomach, Guts, Call, Mesentery, Sweetbread, &c. and that the Spleen it self is nourished with some portion of the said Blood, and sends the rest to the parts of the body. And he conceives that the liver makes blood for the rest of the parts, especially the muscular parts. And he proves it,

1. Because the bowels of the lower Belly receive their nourishment from the *Vena splenica*, or from the branches issuing therefrom, namely from the branches of *Vena porta* only, and not from the *Vena cava*.

2. Because those bowels are thick, more earthy and base: And such as the like parts are not found in the body besides, and therefore these parts stood in need to receive such blood from the Spleen.

3. And therefore the liver is greater, because it makes blood for the whole body besides: The Spleen less, because it makes blood only for the lower Belly, save when in cases of necessity it is forced to help the Liver.

4. In Dogs the Spleen is long and thin, because the Parts or Bowels of the lower Belly are smaller in a Dog, and less wreathed and folded, than in a Man.

5. There is an evident difference between the Fat

bred in the muscular Parts, or those which are nourished by the *Vena cava*, and that dirty, and soon putrifying Fat, which is bred in the lower Belly, as in the Cal, Guts, Mesentery, &c. Hence arise so many Putrefactions in the mesenterick Parts. And by how much an Humor is thicker (as is the muddie Fat we speak of) so much the sooner it putrifies: As the dreggie fat doth sooner, than the Fat in muscular parts. So the Blood of the Spleen is more disposed to Putrefaction, then that of the liver, and this then the blood of the right Ventricle of the Heart. Moreover, the blood of the Arteries is less subject to Putrefaction, then any of the former; and the Spirit least of all.

6. He believes this to be a most strong Argument, that where a part is found having the substance of the Bowels, there also there are Veins from the *Vena porta*, or the branches of the Spleen: but where a part is consisting of muscular flesh, there are Veins which have their Original from *Vena cava*, as appears in the *Intestinum rectum*, in which by reason of its twofold substance, Nature hath placed two sorts of Veins. In the muscular Part, there are the external Hemorrhoid Veins, which arise from the *Cava*: In the bowellie or guttie substance, there are veins from the *Vena porta*.

These, and such like Reasons prevailed with my Father of pious Memory, to prove that the Spleen drew Chymus, by the *Ramus splenicus*. Which Opinion was at that time embraced by most Anatomists, as *Varolus*, *Posthius*, *Jessenus*, *Platerus*, *Baubinus*, *Sennertus*, and *Riolanus* in his first Anthropographia. But that Age deserves excuse, as being ignorant of what Posterity hath since found out. For the milkie veins discovered by *Asellius*, do shew, that no Chyle thick or thin, is drawn by the Mesaraick Veins, or carried any whether, but by the milkie Veins only to the Liver, and not to the Spleen. Moreover, a Ligature in live Dissections declares, that nothing is carried through the Mesaraicks to the Spleen, but contrariwise from the Spleen to the Mesaraicks. Yet I allow thus much to the aforesaid reasons, that there is a certain Generation of Blood made in the Spleen, by the manner hereafter to be explained, not of Chyle, which hath here no Passages, but of Arterial Blood, sent from the Heart.

Hofmannus and *Spigelius* bring the dreggie part of the Chyle, through the mesaraick Veins unto the Spleen, that it may be there concocted into Blood. Who are in the same fault.

For the Arteries are ordained to carry blood to the Mesentery, which is very manifest by Ligatures, and it is contrary to the course of Nature, for the blood to be carried, and the Chyle brought back the same way, lest they should be mingled together. Moreover, in live Anatomists, there was never any Chyle observed there. And the dreggie Portion of the Chyle, which no part stands in need of to nourish it self, is more fitly purged out by the Guts.

Sperlingerus a learned Man, conceives that this work is performed by the milkie Veins, as to the Liver. Which were a ready way, if the milkie Veins do go to the Spleen, which no man as yet hath been able to observe. Those that thought otherwise were deceived by nerie Fiberkies.

Others who very well saw, that the Mesentery sent nothing to the Spleen, would have the Chyle to come right out from the Stomach to the Spleen, by waies manifest or hidden. They account the manifest waies to be the *Vas breve*, and its branches, by which the spleen sucks the more watry part of the Chyle. But the *Vas breve*, carries acid Juice from the Spleen, but nothing

Whether any
portion of Chyle
be carried to the
Spleen, and what
way?

to the Spleen, no more then the other Veins. Moreover, sometimes it is not inserted into the Spleen, but there is a Branch of the *Splenica* without it. I omit, that the *Vas breve* is never full of the white liquor. *Daniel Horstius* indeed hath in this case substituted the *Vena Splenica*, but contrary to Experience, and the Office of the Veins. The splenick Vein receives all its blood from the Spleen and its Arteries, and returns nothing, and therefore being bound in living Anatomies, it is filled, and swells towards the Spleen, according to the Observation of *Waleus*, but towards the Liver it is emptied. Howbeit *Regius* appeals to the Ligature, that the *Vas breve* swells betwixt the Ligature and the Stomach, and that it is lank between the Ligature and the Spleen. *Bachius* is nothing moved herewith, though he cannot untie the knot, and *Hogeland* is various in this Observation; so that I much doubt, whether the *Vas breve* is alone so filled, before I shall see it attested by the Eyes of some others.

Besides the *Vas breve*, *Carolus Piso* proves that the wheyish and potent matter, is drawn out of the Stomach, by the Gastrick and Epiploick Veins; who was ignorant of the motion of humors in these veins. Both the vessels disburthen themselves into the *Ramus Splenicus*, and then the blood is sent by a straight Passage unto the Liver, and returns unto the Spleen, without any hindrance of the Valves.

Those who are for hidden Passages, would force upon us, either the Pores of the Stomach, or a distinct vessel, to us as yet invisible and unknown. Among the former is *Veslingus*, among the latter *Comringius*, who nevertheless differ, touching the Concoction of the Humor. *Veslingus* will have the Spleen to make blood of the more watry Portion of the Chyle, with the earthy and slimy parts mixed therewith, drawn by the invisible Pores, like the milkie veins, resting upon the stomach it self, and the Pancreas. *Comringius* will have only the potent liquor to pass by a vessel to us invisible, by reason of the close sticking of the Spleen to the stomach, and the Serum therein contained, which is not so white: Which Vessel will at one time or other be discovered. But all would be well, if those men that have eyes in their heads, would shew us either those Passages, or that peculiar Vessel. The Pores are too narrow for the dreggy parts of the Chyle to pass through, and who can hinder them sweating out some other way, rather then into the Spleen? Many times when the Spleen stuck not so close to the stomach, I could see no vessel, nor could I see any such thing in a Youth, who having largely drunk, was here lately choaked with a bit of a Neates-tongue.

Howbeit, *Reusner*, *Piso*, and *Comringius* lately praised, do suppose, that only potent matter, is by the Spleen presently sucked out, and that therefore it makes only watry Blood ordinarily. But there is no strong and sufficient reason for this Opinion, seeing there are no manifest Passages. Nor must it only draw that which is thin, which both the Blood and Chylus stand in need of, as a vehicle or carrier, though it flow not alone, but is variously mixed with grosser matter, according to the Constitution of the blood; till having plaid its part, it is either separated by the Kidneys, or sweats through the whole Habit of the Body. If the wheyish moisture be præternaturally separated in the stomach, from the thicker Chyle, either it is voided by Vomir, and the grosser Chyle wanting the help thereof to carry it, will make the Colick in the Guts, as I saw in our famous *Warmius*; or it is voided through the *Pylorus*, which is alwayes open for liquid meats, and such as are easily digested, according to the Observati-

on of our most desired *Waleus*; much more after much drinking, which is sometimes in great Drinkers, quickly voided by urin, not passing through the Spleen, but through the Guts, if there be a conveniency of quality, thinness of Humors, looseness of the Vessels, and strength of the attractive Faculty. All which considering, *Afellius* rightly avouches there is no way so long, which is not soon passed over. In such as are otherwise constituted, Drink does not so soon slip away by Urin. For some will drink all day, and never use a Chamber-pot. In some also their Belly becomes loose, and the Drink goes away, questionless, by the Guts. The blood, indeed, of Splenetic persons, is thin and watry, not that it comes such immediately from the stomach, but the fault is in the whole blood, communicated by the Arteries to the Spleen. I pass over, how that these are the signs of a disordered Spleen, from the præternatural state whereof, no good Argument can be drawn to prove any thing, touching its Natural condition; by which Answer, all other Arguments brought by most learned men, for this potent Chylus are answered.

It is a doubtful question, why only *What Creatures* such Creatures have Spleens, which *have no Spleen?* have Kidneys and Bladders, according to *Aristotle*, which *Panarolus* found true in a Chamaeleon.* Is it because of the Attraction of wheyish Humors? I cannot beleive it. But they have no Spleen, because they make little blood, and therefore the wheyish Humor did not want peculiar Receptacles, but the Superfluities of the blood is spent upon Feathers, Skin, Scales, &c. They are therefore without a Spleen, because Fermentation was not necessary, in the imperfect Concoction of those kind of Creatures, who have a perpetual and Natural Lientery.

Riolanus hath lately in his Enchiridion out of all these Opinions, hammer'd a mixt action of the Spleen, to attract slimy Blood for its own Nourishment, and after that to pour out a certain particular fermentative Whey, through the splenetic Arteries into the stomach, and because its flesh is of a drinking Nature, to draw and suck superfluous Liquor through the Veins out of the stomach. To which I have already answered, part by part. The Action verily of the Spleen is more noble, then to receive superfluous Humors out of the stomach. And through what Passages should it do that? For the Office of the Veins is, to carry back the blood in the parts, out of the Arteries to the Trunk, according to the Doctrine of the Circulation, which *Riolanus* does here vainly oppose. And Ligatures in living Anatomies do shew the same.

Franciscus Ulmus, *Carolus Piso*, and *Æmilius Parisanus*, will needs have it that the Spleen makes Arterial blood, for the left Ventricle of the Heart, as the Liver doth for the right Ventricle. Which Opinion is confuted, because, 1. There is no way by which the blood here made, can go into the left Ventricle of the Heart; for it cannot go by the *Aorta*, because of the Valves there placed at the mouth thereof. 2. There would be a mixture of perfect and imperfect Juice, if by the same way, and at the same time the Heart should receive and return blood. 3. Many Creatures live without a Spleen, which generate Vital Spirits nevertheless.

Mr. De la Chambre in his Treatise of Digestion, supposes that the Spleen makes Spirits for the use of the Belly. But there is Spirit enough to nourish and vivifie the inferior Parts, supplied from the *Aorta*. But if he understand some qualification of the spirituous blood accommodated to the use of the belly, he deserves to be excused.

Whether the Spleen be an Organ of the sensitive Soul? Helmsius a late Writer, hath defined the Spleen for more noble Actions. He gives it out to be the seat of his Archæus, which being the immediate Organ of the sensitive Soul, determines the Actions of the Vital Soul residing in the stomach. He calls it the Seat. 1. Of the Understanding, wherein the Conceptions thereof are formed, because it is of all the Bowels the fullest of Blood, and enriched with very many Arteries; and the Brain does only keep the Conceptions sent to it from the Spleen. 2. Of Sleep and Dreaming. 3. Of Venery, because Pollutions are in the Spleen; and from the stomach, the first motions of lust are perceived: For they are said to proceed out of the Loins, in which the Spleen is the principal Vital Member. Finally, persons troubled with the Quartan Ague, are not subject to lust, because their Spleen is diseased. 4. Of sundry Diseases, which are accounted to be Diseases of the Brain and Chest, as the Tifick, Pleurisie, Apoplexy, Falling-sickness, Night-mare, Swimming of the Head, &c. But 1. All these Conceits bottom upon a false Foundation. 2. No sound Anatomist will grant that the stomach and not the brain is the seat of the Soul. 3. The Spleen is full of blood for other uses, that it may prepare acid blood for the fermentation of the whole blood and the Chylus. 4. There are Living-Creatures, that both sleep, and are addicted to Venery without any Spleen, or though they have a Spleen, when the same is diseased. 5. Nocturnal Pollutions spring from an hot Constitution of the Spermatick Vessels, and wheyish sharp Blood, as the Dissection of the said Parts does declare. 6. That is rather to be affirmed touching the Kidneys in the Loins, as shall hereafter appear. 7. Other Parts in the Belly are diseased besides the Spleen; in such as have Quartan Agues. Yet it cannot be denied, but that the Spleen does assist in some measure, by administering acid blood. 8. The Spleen is but the remote seat of the foresaid Diseases, by reason of Vapors raised from thence; but proper Diseases which spring not from Sympathy, do primarily depend upon the Brain.

The Opinion of Walæus touching the use of the Spleen.

The last and truest Opinion, is that of Walæus, my quondam most worthy Master, founded upon ocular Inspection, and most certain reason. He finding in live Anatomies no motion of Humors through the *Ramus splenicus* of *Vena porta* to the Spleen, did certainly conclude, that it was unlikely, that either Melancholy or Chyle is carried out of the Liver into the Spleen, by the *Ramus splenicus*; and that therefore the Spleen receives no melancholick Excrement from the Liver, nor that any blood is made in the Spleen of Melancholy or Chylus. But contrariwise he observed alwaies, that all the blood was carried, both swiftly and strongly enough perpetually out of the Spleen into the Liver, as also the blood which comes out of the Hemorrhoidal Vein, the *Vas breve*, and other Veins which are joyned to the *Ramus splenicus*. And that there is no motion of Humors to the Spleen, unless by the *Ramus splenicus* of the *Arteria Celiacæ*: And therefore the Spleen does not receive any matter to change and alter from any place, save the *Arteria Celiacæ*. And he conceives that it is most likely, that the blood being further to be perfected, is dissolved by the Heat of the Heart, and that when it is forced from the Heart, through the *Celiacæ Arteries* into the Spleen, the whole mass of blood is not retained by the Spleen, but as the Gall-bladder contains only Choler, so the Spleen holds only the a-

cid or sharp part of the Blood, which you may call Melancholy, just as we see the acid Spirit separated from things that are distilled: And that the said acid Humor is perfected by the Spleen, by means of which the Spleen appears black and acid. And that this sharp Humor is afterwards mingled with Blood in the Veins, and with Chyle in the Stomach, and makes them thin: And that therefore the Spleen being obstructed, gross Humors are multiplied in the Body, not because thick Humors are not drawn by the Spleen, which naturally are never found there; but because the Spleen cannot communicate that attenuating acid Humor to the Blood or Chyle. And that, as much of this acid Humor, as is unfit for Digestion, is voided with the Serum by Urin, for such acid Liquors, as Vinegar, Spirit of Sulphur, &c. are easily mingled with Water; and the said acid Humor, by Distillation may again be separated from the Urin.

In as much therefore as the Spleen draws the sharp part of the blood out of the Heart, and sends it prepared to the Mesentery, that the rest thereof being to be wrought by the Liver, may become more pure and clear; the Opinion of the Ancients may be allowed, which held the Spleen to be the seat of Laughter: For the cheerfuller, and livelier Animals, or live Wights, have great spleens; the more lascivious have great livers; the gentler have little gall-bladders; the fearfuller have great hearts, and the lowdest, have large lungs, &c. Whence that Verse had its Original.

*Cor ardet, pectus loquitur, sed commovet iras,
Splen ridere facit, cogit amare jecur.*

Heart fears, Lungs speak, the Gall
moves anger fel,
Spleen makes us laugh, *Liver
doth Love compel.

*Tis called
Lower in the
North of En-
gland, & pos-
sibly that is the
Exymote of
the Word.

The Spleen therefore prepares blood to accommodate the Bowels of the lower Belly, and of the whole Body after the manner aforesaid. And the excrementitious part of the blood, which cannot be separated by the Spleen, if it be thin and watery, it is purged out.

1. By the Arteries, not only to the Guts, but also to the Kidneys by the emulgent Veins. Hence in Diseases of the Spleen, Urins are many times black, for which cause in such cases we administer Diureticks. And splenetick and melancholick persons so called, abound with wheyish Humors, as is well known from Hippocrates and Galen, for serum ought to be the vehicle or carrier of the grossest Humor. Hence is it, that persons troubled with the Quartan Ague, do most plentifully sweat and piss: Also when it is very plentiful, by the Hemorrhoid Veins. 2. By the stomach, whence in the Scurvey, the Patients spit exceedingly, as also in the Quartan Ague, so that Galen places spitting and spawling among the signs of that Disease. Hence also melancholick persons are wont to be extream spitters. Now it comes from the Spleen to the stomach, not only by the *Vas breve*, but also by other near Vessels.

If the Excrement of the Spleen be thick and earthy, it is voided directly by the Fundament, and comes not at the stomach, for 1. From Melancholy as Galen tells us, comes the blackness of the Excrements. 2. By reason of its weight and heaviness, it settles downwards. 3. The evacuation of Melancholy by the internal Hemor-

How its thick.

rhoid

rhoid Veins, does free men from melancholick Diseases present, and preserves from future, as the divine Hippocrates teaches in many places.

Chap. XVII. Of the Kidneys.

The threefold excrement of the Blood.

A Threefold Excrement is purged from the Blood; thin Choler into the Gall-bladder, thick Choler

into the *Canalis biliaris*, and Whey into the Kidneys. And because we have already spoken of the Receptacles of the two former Excrements, we shall now also speak of the third.

The Kidneys are termed *RENES*, from flowing, because the Matter of Urin does flow through them. In Greek they are termed *Nephroi*, as if you would say

The true Exposition of the Kidneys.

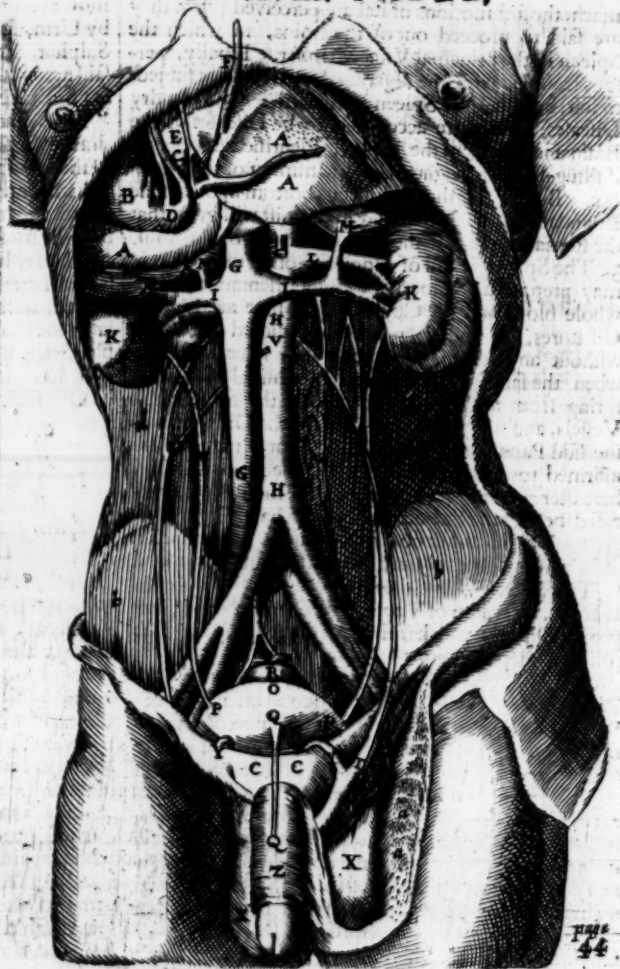
Pissers: From which Etymology that taken out of *Varro*, differs not much. viz. that they are called *Renus*, as if you would say *Rivuli* Rivolets or little Springs.

The Explication of the FIGURE.

This FIGURE shews the Urinary Instruments, and Parts serving for Generation in Men, in their Natural Situation.

- AAA. The hollow part of the Liver.
- B. The Gall-bladder.
- C. The Choler-passage or *Ductus biliaris*.
- D. The Vena Cystica or Gall-bladder Vein.
- E. An Artery distributed both into the Liver and the Gall-bladder.
- F. The Navil-vein turned upwards.
- GG. The descending Trunk of Vena cava.
- HH. The descending Trunk of the Arteria magna.
- II. The Emulgent Veins.
- KK. The Kidneys in their Natural Place.
- LL. The Emulgent Arteries.
- MM. The Capsule atrabiliaria, with Branches distributed into them from the Emulgent Vein.
- NN. Ureters descending from the Kidneys to the Bladder.
- O. The bottom of the Piss-bladder.
- PP. Inferiour of the Ureters, into the sides of the Bladder.
- QQ. A Portion of the Urachus or Piss-pipe.
- R. A Portion of the right or straight Gut cut off.
- SS. The preparatorie Vessels, of which that on the right hand is bred out of the Trunk, that on the left out of the Emulgent Vein.
- T. The Pyramidal Body arising from the Union of the Veins and Arteries preparatorie, expressed on the left side.
- V. The Original of the preparatorie Arteries from the Trunk of Aorta.
- XX. The Stones, the left being laid open from its common Coat.
- YY. The Vasa deferentia which ascend from the Stones to the Belly.
- Z. The Yard.
- aa. The Cod, which covered the left Stone, separated therefrom.
- bb. The Iliac or Flank.
- cc. The Share-bones.
- dd. The Loins.

The XVIII. TABLE.



Their Number | The Kidneys are two in number, because among all Excrements, the wheyish is most plentiful, and exceeds the two excre-

mentitious Cholers, by reason of the Blood, whose vehiculum it was to be, until it come into the large Veins of the Cava; and that one being diseased, the other might

Whether when one Kidney is diseased the other ceases to perform its office? might draw the wheyish Humor; but I am not of the Opinion of *Beverovic* and of *Loefstus* after him, that one Kidney being diseased, the other draws the wheyish Humor.

For the contrary is seen in such as have one Kidney only stopped with a great stone, or consumed by an Ulcer; and the contrary to what he imagines, is seen in other parts, for one Eye being hurt, the other sees; and all the scollups of the Lungs being consumed on one side, that on the other side does further Respiration, unless haply both parts be affected by some common Cause, for otherwise they must be forced to say, that that happens only sometimes. There is seldom found only one, and then it is a great one placed in the middle, for otherwise the body should not be well balanced, nor could the Vessels be conveniently carried. This monstrous, when both the Kidneys are joyned into one beneath, and cleave together, as I have seen at *Padua*. This more rare to find three or four placed one upon another, or one beneath another.

Their Situation. They are situate under the Liver and Spleen, where they rest upon the Muscles of the Loins, between the two Coats of the Peritonæum, at the sides of the *Vena cava* and *Arteria magna*, under which very great Nerves lie hid, both of the Muscle *Psoas*, and others, which evidently pass this way unto the Thighs. Whence it is that a stone being in the Kidney, a numbness is felt in the Thigh of the same side. It is a rare case which *Cabrolinus* hath observed, for the Kidneys to rest upon the

Which Kidney is the highest? Back-bone of the Loins. Nor are the Kidneys seated just one against another, least there should be some impediment to attraction, and least some part of the wheyish humor should slip aside. But the right-side Kidney is lowest in Men, to give way to the Liver, under which it rests immediately, reaching by its end, the third Vertebra of the Loins. It is seldom higher than the left, and seldom are the two Kidneys seated one just against another. The left Kidney for the most part, lies partly under the spleen, but is seldom higher than the spleen. Contrariwise in Brutes, the spleen goes more downwards, and the right Kidney lies higher, and therefore there is a Cavity in the Liver by means of the Kidney, which does not Naturally happen in men. Here some observe that the right Kidney is nearer to the *Cava*, and the left more remote, by reason of the left Emulgent Vein, which is much longer than the right.

Their Bigness. They are not alwaies both just of one bigness, but for the most part they are. They are commonly of the length of four Vertebra's; their latitude for the most part, three fingers, their thicknes that of a thumb, yet the right Kidney is very many times larger than the left, because by reason of the heat of the right part, it draws the wheyish blood more vehemently, unless it be fretted by some Disease, for then it grows lean and thin. Also such as are given to fleshy desires, have larger Kidneys than ordinary. But their Proportion is not alwaies alike convenient for the body.

Surface. The Surface of the Kidneys, as in the liver is slippery, and smooth: It is seldom in Mankind uneven, as if it were composed of many Kidneys or kernels, which any man may frequently find in a Child yet in the Womb. But the Kidney is alwaies so made, in an Ox and Bear, in a Calf, and most curiously of all in a Surgeon, in which the Kidneys are made up like bunches of Grapes, of

triangular and quadrangular dies or tiles as it were after an Artificial manner, as I have demonstrated in the Anatomy of that Creature.

The Colour of the Kidneys is a dark red, but seldom intensely red. In diseased persons the Kidneys are variously coloured, even as the Liver and Spleen are.

The Kidney is shaped like a kidney-bean so called, also like an Alarum leaf, if you respect the plane surface. Externally in the Back or about the Flanks, it is of a round, bunching shape; beneath towards the upper and lower part it is bossie, but in the middle concave and hollow. *Helmont* hath seen the left Kidney triangular, and in the same person the right Kidney not so big as an Hazel-nut. *Hippocrates* compares the kidneys to Apples: Without doubt to the broader sort of red Apples; unless by the word *melosin* he intended the likeness of the kidneys in man to other Creatures.

They are knit by an external Membrane, which is from the Peritonæum, to the Loins and Midriff, and by the emulgent Vessels to the *Cava* and *Aorta* Vessels, by the Ureters to the Bladder. And the right kidney, to the blind Gut, sometimes also to the Liver, the left to the Spleen and Colon. Hence pains of the kidneys are exasperated by plenty of Winds and Excrements.

They have a double Membrane: The first internal one near and proper, being very thin without Fat and Veins, from the external and common Coat of the ingredient Vessels dilated (for a Vein only goes in with but one Coat) which growing very close, makes the flesh more compact, and being turned back inwards, it accompanies the Vessels, enters into, and invests their Bellies. Another external from the Peritonæum, which adheres but loosely, whence they term it the *Swath-band* of the kidneys. For it is as it were a coverlid or blanket of the kidneys; and because it is encompassed with much Fat, for the sake thereof, it hath received the *Vena adiposa* so called, that is to say the Fat-vein, so that in fat persons, the kidneys lie quite hidden. Whence he that knows or searches into hidden things, is said to search the Reins. For the Scripture uses two words *Pelajoth* and *Taboth*, the former of which *Mercerus* will have to be

derived from a word signifying to perfect and finish, because there is in the Kidneys a power of consulting, and finishing things consulted upon: The latter they derive from *Tach* a blot, and from the Radical word *tivvach* to daub, or plaster, and crust over, because the Kidneys are crusted, and hidden as it were with Fat. Some indeed explain the Phrase of searching the Reins to be meant of Concupiscence carnal and venereal Delectation, from the word *Calab* to desire, Witness *Rabbi David*, and *Pagnine*, or from *Celi* a Vessel, because in and from the Kidneys is the desire of Venereal pleasures. Howbeit this also is a secret Quest, stolen pleasures Venereal seeking the night and dark places and secret carriages, which I have largely demonstrated in my *Vindice anatomica* against *Hofman*. Fat is bestowed upon them to preserve the Heat of the Kidneys in regard of plenty of Serum which would overcool them, and to defend the Vessels. There is less about the right Kidney if we believe *Aristotle*, more about the left, because the Heat of the right Kidney, either suffers it not to congeale, or melts it when it is congealed.

They have a substance or flesh hard compact and dense. like that of the

Heart,

The FIGURES explained.

This TABLE propounds the Kidneys both whole and cut asunder, that the Ingress and Egress of the Vessels might be discerned.

FIG. I. Shews the Form of the Kidneys and of the Emulgent Vessels.

- AA. The common Membrane of the Kidneys compassed about with Fat, and here separated.
- BB. The Capsule atrabilaria, or auxiliary Kidneys.
- CC. The Kidneys.
- D. A Particle of the proper Membrane of the Kidneys separated from the rest.
- EE. The Trunk of Vena cava descendens.
- FF. The Trunk of the Arteria magna descendens.
- GG. The Ureters or Piss-channels.
- HH. The Emulgent Veins.
- II. The Emulgent Arteries.
- KK. The Spermatick Veins, or Seed-veins.
- LL. The spermatick or Seed-arteries.
- m. The Vena adiposa or fat Vein from the Emulgent.
- n. The Arteria adiposa, the fat Artery.

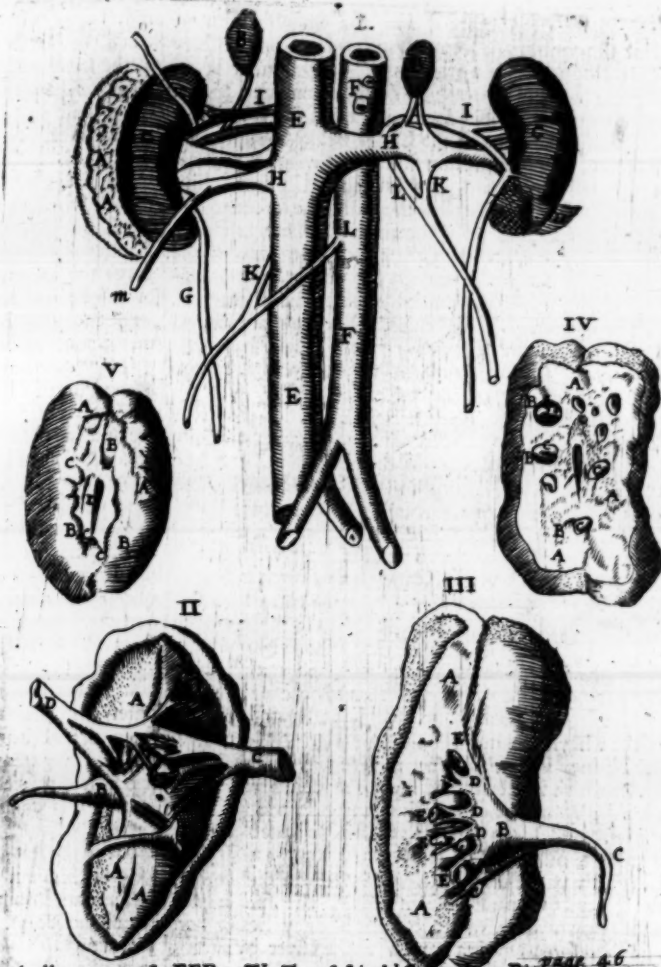
FIG. II. Shews the Entrance of the Emulgent Vessels, into the hollow part of the Kidneys.

- AAA. The inside of the Kidney cut open,
- B. The Basin of the Ureter.
- C. The Emulgent Vein spread by sundry Branches into the Kidney.
- D. The Emulgent Artery variously divided, joining it self to the little Branches of the Veins.

The III. FIG. Shews the Rise of the Aorta.

- AAA. The Kidney cut open.
- B. A large Cavity, or the Basin of the Ureter, about the Kidney.
- C. The Ureter looking downwards.
- DDD. Little Pipes embracing the Caruncles of the Ureter.

The XIX. TABLE



EEE. The Teat fashion'd Caruncles or Bristles of Flesh, which do strain the Urin into the Kidneys.

The IV. FIG. Shews the Caruncles.

AAA. The appearance of a Kidney split open.

BBB. The Mouths of the Ureters, which compass the Caruncles opened.

CCC. The Papillary Caruncles so called, which strain the Urin into the Kidneys.

The V. FIG. Shews the Kidney cut open to its Belly.

AAA. The Kidney divided through the bossie part.

BBB. The Caruncles cut through the middle.

CCC. The Pipes of the Ureters.

D. A Wound piercing into the Belly of the Kidney.

Heart, but not so fibrous, because the Fibres of the vessels are there. But on both sides of the internal Cavity, the Fat being removed, there appears a loose substance, uneven and hollow. This flesh sometimes is consumed and putrefies, whence comes worms in the kidneys. In a Dog I have seen a worm so great in the right kidney which lay hid like a snail, that beside the external Coat of the kidney, there was none of the flesh left.

The kidneys have two Bellies as it were, Their Bellies, the outermost in the hollow part which Fallopius calls *Porta*; through which the emulgent vessels are carried, and first they enter bipartite or divided into two, and soon after they are commonly divided into four, and so spread abroad into the whole substance of the kidneys, till at last they are consumed and spent into very small and fine threads. The inner Belly is nothing but the large Cavity of the Ureter, that is to say

say a membranous Cavity, made of the Ureters, spread out and widened in the Cavity of the kidneys. But the Ureters in their progress are not attenuated within, as other Vessels are, but they have the ends of their branches (eight or ten for the most part) broad and open like Pipes, embracing certain Caruncles, or little fleshy Eminences.

The Caruncles. These Caruncles are like kernels, less coloured and harder than the rest of the flesh. *Carpus* was the Finder out of them, though *Rondeletius* saies that he did first observe them, and calls them Mammillary productions. Others call them Papillary Caruncles, because they are very like the Nipples upon Womens Dugs: They are as big as Pease, somewhat broad above, convex beneath, and they have very little holes bored through them, so that they will hardly permit an hair to enter, which furrows and little channels may be observed, if the kidneys be cut long-wise. I have instead of these found stones in an Ox. The holes were to be exceeding small, lest the blood which is requisite to nourish the kidneys, should with the Serum and Choler flow into the Ureters, which indeed happens when the kidneys are diseased or the Passages too open.

They have Vessels of all kinds. Veins from the Cava.

The emulgent Veins and Arteries.

A Valve in the Vein.

1. The emulgent or milking Veins so called from their Office, which are great and remarkable by reason of abundance of wheyish humor in the Body: In which *Baubin* saith there are Valves to be seen, which hinder the return of serum into the *Vena cava*. But Experience teaches otherwise, for with their broad end they look towards the *Cava*, and with their sharp and lunary part they respect the kidneys, by which they are opened, according to the Opinion of *Dr. Harvey*, which I have found true, and demonstrated by visible Inspection, so that any matter may easily repass, from the kidneys by the Emulgents to the *Vena cava*, in the solemn Circulation of the Blood. By a short and crooked passage they are carried downwards to the hollow part of the kidneys, as also the emulgent Arteries, which are remarkable and large, derived from the Trunk of the Aorta, unto the kidneys, nor so much to furnish vital Heat, to resist coldness, as to nourish the kidneys, and to purge away the wheyish humor, which is most plentifully contained in the Arterial blood. For these emulgent Vessels are seldom one like another, or one in number, sometimes with six, five, four, three, and for the most part two branches, they go distantly to the kidneys, and that either on the one or both sides, seldom on one alone. And when they have entered the hollow part of the kidney, each branch is suddenly subdivided into four or five little ones, which being again divided into other lesser ones, they are at last spent into Veins and Arteries as final as hairs, which end at the Heads of the Caruncles, into which they shed their wheyish humor, that it may distil into the little Pipes of the Ureters: Yet are the Emulgents never opened at the Pipes of the Ureters. For wind or water being forced in, it flows indeed through the Emulgents, but it goes not out by the Pipes. Into the left Emulgent in some bodies there is implanted a branch of the *Vena azugor* so called, which is thought to be the cause of that Consent which is between the Chest and the Kidneys, which the Arteries do not a little further.

Vene adiposa. 2. The *Vene adiposa*. The right being drawn from the Emulgent, seldom from the Trunk, the left from the *Cava* to the outward Coat, which contain blood to nourish

the Fat. Moreover, the kidneys need no other Vessels to nourish them besides the Arteries, as the *Vesica biliaria* or Choler-bladder, and the *Piss-bladder*; for they do not draw a pure Excrement as those do.

The Kidney hath one very small Nerve on each side, from the Stomach-branch of the sixth pair, distributed into its proper Membrane, whence arises the Sympathy between the kidneys and the stomach, as when persons diseased in their kidneys, are troubled with stomach-sickness and vomiting. But there are a few branches of Nerves, which proceed from about the beginnings of the Arteries of the Mesentery, part of which enters into the hollow of the kidneys with the Emulgents, and is disseminated through their substance. Hence persons having the stone in their kidneys, have more vehement gravative and stretching pains: But their pain becomes more sharp, when the stone enters into the narrow and very sensible Ureters.

Now this is the structure of the Kidneys in Mankind. For in a Dog it is otherwise, in whose kidneys there are other Cavities; but in the kidneys of a Man there are none, save what are formed by the Emulgents and Ureters variously divided.

Also there is a feigned Dream of some of the Ancients, touching the *Cribrum benedictum* by them so called. For they feigned that there were in the kidneys, two Cavities seated according to their length: The one uppermost, into which the wheyish blood should be poured out of the Emulgents, the other lowermost, which a certain transverse Membrane was thought to sever like a sieve bored through with very small holes, which made them call it the *Colander*, and the blessed sieve, through which they would have the Serum strained into the Ureters, and the good blood to stay behind to nourish the kidneys: These Dreams of the Ancients *Vesalius* did rightly reject; but he is mean while deceived, while he would have such Cavities in the kidneys of men, as there are in Dogs kidneys, and will not have the kidneys of a man or sheep to be cut up, because of the Fat. *Riolanus* defends this Opinion of the Colander or Sieve, but he explains it only of the Caruncles (as I do) which are pierced through with very small holes.

Their Use. *Erassistratus* and the followers of *Asclepiades* did conceive that Nature had made the kidneys in vain. And *Aristotle* sometimes saies, that there is no need of them. But

Their Use is to draw the wheyish blood, by the emulgent Arteries, that so the mass of blood may be purged. The blood therefore going out through these Vessels, is always carried through the branches of the Emulgents, which are spread abroad through the whole flesh of the kidneys, and go at last into very small passages, so that at last the wheyish Humor is poured right out into the flesh of the kidneys: But the sanguine and laudable portion, does partly remain to nourish the kidneys, and partly returns by little emulgent Veins which are open into the *Cava*, and so to the Heart. The wheyish and watry part is strained through the Papillary Caruncles, which have holes into the branches of the Ureters, which grow together into one large Cavity or Expansion of the Ureter, into which the wheyish hu-

Their Nerves.

Why such as have a stone in their kidney are subject to vomit?

The structure of a Dogs kidney.

The Cribrum benedictum of the Ancients.

The Error of Vesalius.

Aristoles Error touching the use of the Kidneys.

How the Urin is made?

ish humor is emptied, and through the Ureters into the Bladder, where it becomes urin. And because urin is yellow, a portion of yellow Choler not drawn out by the Gall-bladder, is thought to pass along with the Serum or wheyish humor, that the Ureters might be clogged by Choler, as the Guts are.

Whether the Kidneys prepare Seed? *Olshafius, Sennertus, Olaus Wormius,* whom a great many others have followed, as *Hofman, Meybome, Horstius, Lofeleus, Richstadius, Sperlinger,* and others have attributed to the Kidneys

the preparation of Seed, because hot Kidneys cause a propensity to fleshy lust, and cold Kidneys indispose to Venerie, and because in Creatures that use Venerie, the kidneys have a rank smell and taste of Seed, which in guedled Animals they have not. Because in a Gonorrhæa proceeding from abundance of Sperm, Remedies are successfully applied to the kidneys: because men are said to proceed from the Loins of their Progenitors, and they have been famed for the seat of Lust: Because the Loins being whipped, do raise an Appetite to Venerie: And finally because in persons given up to lust, the kidneys are consumed. Which Arguments are indeed of some weight, unless peradventure that smell and taste happen to the kidneys, because they are nourished with such a nutriment as is the matter of Seed, which is carried for the Generation thereof in bordering Vessels. And when the kidneys are hot or cold, the neighbouring places are also hot or cold, through which the matter of Seed is carried, and in which it is altered, and therefore Seed may have affinity to the Constitution of the kidneys.

This Opinion reconciled with the Doctrine of Circulation.

For *Johannes Waleus* conceives that the Circulation of the blood cannot admit this use of the kidneys, for blood is not carried from the kidneys to the stones, by the Emulgent and Veins: but it falls down only out of the Aorta by the Spermatick Arteries. But this action of the kidneys defended by such Learned men, may be reconciled with the circular motion of the blood, if we shall say. 1. That the more wheyish part of the Arterial blood is drawn by the kidneys through the emulgent Arteries, whereby the rest which descends right along through the Spermatick Arteries, becomes more pure and fitter to make Seed. Of which this is a sign, that when the attraction of the kidneys is weak, and the blood comes to the stones more wheyish than it ought to be, the seed which is voided, is unfit for Generation, though plentiful in quantity. 2. That the neighbouring Spermatick Vessels are irradiated and virtuated by the kidneys, even as the Brain irradiates the lower Parts, by an inbred property resembling light. 3. If any thing should be carried from the kidneys to the stones, we might very well say, it is a wheyish substance, which stirs up a sharp titillation and strong provocation and desire to Venerie. For I am not persuaded by the Arguments of *Helmont*, that the salt of the Urin takes away the fruitfulness of the Seed, if it be moderate, seeing it helps the Seed both by its acrimony and fluidity or thinness of substance. Little Birds, indeed, though very lascivious, have neither kidneys nor bladder; yet they have somewhat that supplies the Office of the kidneys, viz. certain Caruncles or little parcels of flesh, which resemble the kidneys, which are continued with the *Vena cava* and *Aorta*, Witness *Aristotle* and others.

Whether the Kidneys make Blood?

Beverovicus attributes a kind of Sanguification or Blood-making to the kidneys. 1. Because they have a Parenchyma, and very many Vessels.

But they might have their Parenchyma because of their Vessels, that they might not be intangled one with another. And it was requisite they should have very many Vessels, to the end they might plentifully purge away the Serum or wheyish part of the Blood, so that through very many and very small outlets, the Whey might be issued out into the Caruncles, without any considerable quantity of Blood therewith. 2. Because the Kidneys which in healthy persons are red, clear, solid; according to the kind of the Disease, become sometimes obscure and blackish, sometimes whiteish; otherwhiles loose, brittle, and as it were rotten; and sometimes again, hard and dried. But that might happen, because as some other parts, so the kidneys might be sick, or through sickness of the Body, Concoction being somewhere hurt, they could not be nourished with good blood. 3. Because the Urins of persons troubled with the stone are crude: But of that another cause is commonly rendered. Viz. in that the kidneys being stopped, the thinner part only of the Urin can make its way forth. 4. Because persons troubled with the stone are wont to swell and look pale, like those that are termed *Leucophlegmatici*. But this may easily happen, because the kidneys either through weakness cannot sufficiently draw the wheyish humor out of the blood, or being stopped it cannot be duly expelled. But if he or any other shall affirm, that allowing the Circulation of the blood in these parts, the blood is there somewhat more changed, then it was in its simple Vessel, I shall not disagree with them therein. For themselves it is that they change the blood, but it is for the rest of the body only, that they purge out the wheyish Excrement.

Chap. XVIII. Of the Capsule Atrabiliaria, or Black-choler Cases.

These Vessels are by most Anatomists neglected and not observed, though they are evermore found in all Bodies, what ever *Archangelus* saies to the contrary. Nor must we say that these Capsulae are made of a superfluous Matter, as a sixth finger uses to be.

We are beholden to *Bartholomæus Eustachius* for the first discovery of these small Bodies, who mentions them by the name of *Kernels*, and after him *Archangelus* and *Bauhinus*. *Casseri* calls them *Renes succenturiatos* Deputy-kidneys or Auxiliary kidneys. I shall call them, in regard of the use I allot them, *Capsulae atrabiliaria*, Black-choler Cases.

Now these Cases are so seated, that they rest upon the upper part of the kidneys on the outside, where they look towards the *Vena cava*, being covered with Fat and Membranes.

Their number is the same with that of the kidneys. For upon each kidney there rests a Case. I have once seen four of them, of which the two greater being four square were seated above, and the two smaller being round, uneven, and rough, were placed beneath the emulgent Veins.

Their Magnitude is not always alike: commonly that on the right side is bigger then that on the left, yet sometimes the latter is bigger then the former.

In a Child new born, they are near as big as the kidneys,

kidneys, peradventure because they are moister then ordinary, and contain a more thin melancholy Juice, which because they do not strongly enough expel, but treasure it up rather, therefore these Cafes are widened. But in grown persons they are strained, and become less, though they abound more with Melancholy, partly because the Melancholy being gathered by degrees, is through the strength of nature by degrees expelled; partly, because the Serum in hotter persons is dried up, wherewith the new born Infant abounded; and partly because as the Reins grow bigger, they are compressed. Yet I have once observed them in a grown person, by reason of abundance of black Choler, twice as big as ordinary, whereas commonly they are no bigger then a large vomiting Nut.

Their Cavity. They have an apparent internal Cavity, both in persons grown and newborn babes, compassing the inner circumference of the whole Cafe as it were, in which they are found to contain a dreggie and black humor, so that even the inner sides are coloured with the said blackness. In Infants I have seen to my thinking wheyish blood in them. I admire that *Riolanus* could not, or would not see this Cavity, for though he cries that it is so small, that it will hardly admit a little Pea, yet is it sometimes wider, and alwaies so large, as to contain many peasen compressed, and we can thrust a Probe into it, this way and that way, without violence. It contains therefore a large Cavity, respecting the smallness of its Body. Nor hath Nature ever labour'd in vain, no not in the smallest spaces of the Capillary Veins. It is a small matter which they can hold, yet it may be counted much, because it is successively received in, and cast out again. This Humor might have been indeed allayed and sweetened by the admixture of blood, as Choler also might, yet Vessels and Receptacles are ordained for both these Excrements, that the blood might not be polluted.

Their Shape and Substance. In Shape and Substance they many times resemble the kidneys, save that their substance is a little looser; so that they seem little kidneys resting upon the great ones. Which perhaps was the Reason that *Casseri* did call them Auxiliary kidneys: But more frequently their substance is flat like a Cake (howbeit hollow within) and their shape is round-long and somewhat square. Sometimes they are three corner'd, seldom round; for they are seldom seen in one and the same shape.

Their Connexion. They are knit where they rest unto the external Membrane of the kidneys so fast, that negligent Dissectors, when they take out the kidneys, leave them sticking to the Membrane of the Diaphragma or Midriff. And this is the Reason that many observe them not.

Their Vessels. They have Vessels: Veins, and Arteries, derived to them from the middle of the Emulgent. Sometimes also a Vein is sent thither from the kidney, and sometimes also a branch near the Liver from the *Cava* is brought therto, sometimes also from the *Vena adiposa*, and sometimes from all those places, sometimes with a single, otherwhiles with a double branch. Sometimes they have a single Artery from the Emulgent, sometimes a double one; and otherwhiles they have from the Trunk of the Aorta, one while a single branch, otherwhiles three together.

These Cafes have Nerves also. For about the beginnings of the Arteries of the Mesentery, some branches of Nerves mixed together are produced, one part of

which goes unto the kidneys, and these Cafes which rest upon them.

Their use hath been hitherto unknown. If it may be allowed to conjecture, as doubtless it is, due consideration being had to the Structure and Passages; we may say, that a thick and excrementitious black-cholerick humor, is detained in these Cafes, which had not been purged from the Blood, made in the Liver, or Spleen, or both, but especially that blood which we formerly proved to be made in the Spleen; which is here kept and digested, because it could not pass through the narrow waies of the kidneys. Nor let the ascending of an heavy substance trouble us, which ever and anon happens in the Body, by means of the expulsive and attractive Faculty of some Part; yea and vehement attraction is advantaged by the highness of Situation in motions Spiritual. Hence also peradventure it is that Urins are sometimes black, when at any time this Humor is collected in the Cafes, in too great a quantity. Where also may be often doubtless, the seat of some morbidick cause, especially of Melancholy. And the reason why melancholick persons are thereby little pained, is because the smallness of the Nerves, and the thickness of the Humor, do render the Sense dull. The renowned *Veslingus* agrees with me in this use, but he shews not whence, nor how the humor comes. For he conceives they help to draw the wheyish humor, and that they treasure up a parcel of black Choler, which furthers the separation of Whey from the Blood, like Runner.

Olshafius will have them to receive the thick and terrestrial Excrements of the kidneys, which remain after their Digestion. And therefore because a greater Bowel hath more Excrements then a lesser, the Conceptacle for the right kidney was to be larger, and that for the left lesser, and therefore the right side Cafe is greater then the left side, because the right kidney is greater then the left. But no man hath thought of the waies by which the black blood should be discharged into these Capsulae or Cafes. The Arteries do easily occur to such as hold the Circulation of the blood. For according to the old Opinion, a way is readily found to these Capsulae from the Emulgent, or from the Trunk of the Aorta itself, which bringing Nutriment such as it is, do withal unlade the Excrement of the Arterial blood, which was not evacuated formerly. But

how it returns out of the Capsulae, how it comes to the kidneys to colour the urins black, is not so easie to shew, for the Veins end in the Emulgent, or in the *Cava* it self, seldom in the kidneys, and so either they should perpetually keep that excrementitious Juice, which is unlikely, or send it back again to the *Cava* and the Heart, or they ought, verily, to enter the kidneys directly by the Emulgent Veins, without any hindrance by the contrary motion of the blood going out of the kidneys. This contrary motion a thicker and stronger humor can easily overcome, manifold branches also opposing the same, as in Rivers we now and then see waters run contrary to the stream, by the banks and in the middle, by reason of some fountains opened. But oftentimes the Vein of the right side Cafe, is immediately inserted out of the Trunk of the *Cava*. And in such a chance, truly, either Capsula or Cafe is not sufficiently purged, whence arises some hidden Disease; or the circular motion of the blood is neglected, which in the

The use according to the Authors Opinion.

According to Veslingus.

According to Olshafius.

How the Humor comes out of the Cafes into the Kidneys.

The FIGURES explained.

The Capsulæ Atrabiliaræ in Men and other Creatures, are here described. In all which FIGURES.

- A. Represents the Cases whole.
- B. Shews them dissected, that the internal Cavities may be seen, which are of various Forms.
- C. Points out their Veins and Arteries, arising from the Aorta and Cava, and from the Emulgents.
- D. Is the Vena cava.
- E. Is the Arteria Aorta.
- F. The Vessels on both sides, called Emulgents.
- G. The Kidneys cropped off.

finallest Vessels doth frequently vary; or if it must be Religiously observed, we must here conceive a Reverberation of the Kidneys; for the Blood flowing back out of the Kidneys through the Emulgent Veins, up to the Cava, because it discharged only Whey and no thicker Juice in the kidneys, it insinuates it self by the Vein next the Capsula, and coming back out of the Capsula by the little Arteries, with the Emulgent Arteries it goes again to the kidneys, and from thence is purged by urin. He that can give the best Conjecture, let him be counted the best Prophet. Spi-

gelius whom *Laurentius* of *Rostock*, does faithfully imitate, has assigned other uses to these Capsulæ. 1. To fill the empty space

between the Kidneys and the Midriff. 2. To prop up the Stomach, in that place which is above the emulgent Veins and Arteries. But I answer, 1. Nature makes, nor does nothing in vain or inconsiderately, much less doth she appoint a noble animated Part, only to fill a space, which she might have filled by making the kidney a little bigger. 2. These props would have been too weak by reason of their smallness. Nor should this use belong to the Stomach alone, but to other neighbouring Parts. *Riolanus* writes that they have no use in grown persons, but that after the Child is born they become useless, and therefore we must seek for their use in the Child in the Womb, when it is great, whose kidneys being void of Fat, the Juice ordained to breed kidney-fat, is received into these Cases: But, 1. Their Cavity, Veins, Arteries, Humors, &c. will not allow us to say they are withered up in grown persons. 2. The use of the Navel-vessels ceases, because the Child is no longer to be tied to its Mother, nor to draw its nutriment from her: And that these Cases or Capsulæ are serviceable to grown persons, was proved before, for otherwise their Veins, Arteries, &

Whether they have any use in grown persons.

When it is great, whose kidneys being void of Fat, the Juice ordained to breed kidney-fat, is received into these Cases: But, 1. Their Cavity, Veins, Arteries, Humors, &c. will not allow us to say they are withered up in grown persons. 2. The use of the Navel-vessels ceases, because the Child is no longer to be tied to its Mother, nor to draw its nutriment from her: And that these Cases or Capsulæ are serviceable to grown persons, was proved before, for otherwise their Veins, Arteries, &

The XX. TABLE

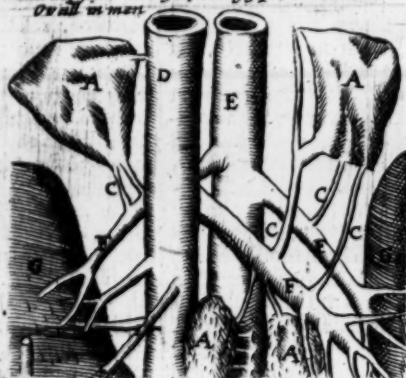
The Capsula or Cases, being round in men.



The Capsula or Cases, being Triangular in men.



The Capsula or Cases, being square and Oval in men.



The Capsula or Cases, in a Lamb.



The Capsula or Cases, in the fish, Trutta.



The Capsula or Cases, in an Oxe.



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end. 3. That the kidneys of Children in the Womb should be alwaies void of Fat, I have found to be false. 4. The kidney-fat is never made of that wheyish black Juice, and hardly any man ever saw an oylie Juice in these Capsulæ.

Chap. XIX. Of the Ureters, or Urin-channels.

THE Ureters or Urin-carriers, are The Ureters. round-long Vessels or Channels, arising out of the Kidneys, planted into the Bladder, into which they carry the Urin from the Kidneys.

The Ureters are commonly two in Number, on each side one, sometimes Their Number. two, & sometimes more, yet al growing into one before their Insertion, as also *Carolus Stephanus* observed in a certain Body. But the far renowned *Riolanus*, in a body infected with the venereal Pox, saw two Ureters on either side, inserted into the bladder at different places, the one towards the neck, the other in the

the bottom thereof. *Salomon Alberus* obſerved three on the right ſide, and but one on the left. I have frequently obſerved the like difference, as among other things I ſhew in my *Rare Anatomical Hiſtories*.

Their Situation. They run through many parts in their beginning, middle, and end. Their beginning is in the kidneys themſelves, what ever *Hofman*, *Riolanus*, *Laurenberg*, and *Plempius* ſay to the contrary; in which they riſe like Roots out of the Earth, and as a Vein out of the Liver. Nor does their ſimilitude with the Bladder move me; becauſe, 1. The Nature of the Ureters is peculiar and diſtinct from them both. 2. They are not much unlike the belly of the kidneys. 3. All Parts do carry with them the nature and colour of their Original, as we ſee in the Aorta and the Cava. Nor does their cleaving faſt to the Bladder infer any thing, ſeeing the connexion is not greater there than in the kidneys, being conveniently ſeparable, between the

The Original of the Ureters. Membrane of the Bladder and the Muſcle. And therefore this Original is in the kidneys, out of nine or ten little Pipes or Channels, to each of which the Caruncles aforeſaid are applied, though the Caruncles may be alſo applied to their middle part being bored through. Now thoſe Pipes go into fewer and greater branches, commonly into three, diſtributed into the upper, middle, and lower Region of the kidney. Theſe grow afterwards into one large Cavity

Their Middle. ty which goes out of the flat ſide of the kidney. The middle part, is the whole long-round Pipe or Channel, reſting upon the Muſcles of the Loins, between two Membranes of the Peritonæum, with which

Their Connexion. The Ureters are faſtened; above to the kidneys, below to the Bladder, with the inner ſubſtance whereof they make one continued Body, ſo that they cannot be

Their End. plucked away without breaking. Their End is, where they are implanted, being carried obliquely a fingers breadth, between the proper Membrane of the Bladder, and its circumvolved Muſcle, not far from the Neck of the

Why the Urin cannot go out into the Emul-gents. Bladder, in its hinder part. And beſides the oblique Inſertion of the Ureters (which cannot at al, or very highly hinder the regreſs of the wheyiſh Humor into the Ureters, becauſe it is broad) two little Membranes are placed

in the Implantation, like the Valves in bellows, ſhutting up the paſſage of the Ureters, ſo that the Urin cannot go back. Hence it is, that the Bladder being blown up, will not admit ſo much as any wind. *Laurentius*, *Riolanus*, and *Plempius* deny theſe Valves, contrary to all other Anatomifts. But though the paſſage be crooked, yet is it open enough. The Gut Colon is not a little wreathed, and the Ileon more than that, and yet they have a Valve affixed. Yea they are themſelves forced to confeſs, that the two Membranes clapt together, do exactly ſhut up the paſſage of the Ureters, and what hinders but that they may be termed Valves.

Their Magnitude. As for their Magnitude. They are long-round Veſſels, thick and hollow, as big as ſtraws. But in Diſſections of perſons troubled with the Stone, we have often ſeen their Cavity ſo wide as to admit two fingers, yea and as big as the Guts.

Figure. As to theſe Figure, they are round Veſſels like Water-pipes, a little crooked like the letter, S.

They have a double Membrane: The Membranes; one common from the Peritonæum for ſtrength ſake, the other proper, like the inner ſubſtance of the Bladder, and continued therewith, white (whence ſome and *Ceſus* among the reſt call them the white Veins) bloodleſs, nervous, thick, ſtrongly furniſhed with ſtraight and crooked Fibres, that they may be ſtretched.

They receive ſmall Veins and Arteries from the neighbouring Parts.

They have Nerves from the ſixth pare, and the Marrow of the Loins. Whence they have an exquisite ſenſe, and are pained when ſtones paſs through them, which ſenſe of pain is encreaſed, by the diſtention of theſe membranous Bodies, cauſed by great ſtones.

Their Uſe is, that through them as Conduits Uſe pipes, the Urin ſeparated from the Blood by the kidneys, may be carried into the Bladder; and ſometimes Gravel and Stones, Worms, Pins, Hairs, Quittor, Blood, &c. Now the Urin is carried by a manifeſt Paſſage formerly explained into the bladder, which Paſſage, becauſe *Aſclepiades* was ignorant of, he would have the Urin carried into the bladder, after a blind manner, as if it were firſt reſolved into a vapor, and did ſo ſweat through, and afterwards became an humor as before: Which tranſudation *Paracelſus* likewiſe held.

The Error of Aſclepiades and Paracelſus.

Chap. XX. Of the Piſſ-bladder

THis Bladder is ſeated in the loweſt part of the Belly, between two Coats of the Peritonæum, in a Cavity fashioned by the Os ſacrum, the Hip and Share-bones (as it were in a little belly of its own, ſeparate from the Paunch) in men above the Inteſtinum rectum or Arſe-gut; in women between the Neck of the Womb, and the Os pubis, and the Share-bone.

Its Magnitude varies, for the greater the Lungs are, the greater is the bladder, ſo that thoſe Live-wights which have no Lungs, have no bladder; and according as it is variously diſtended. For ſometimes being full, it does ſo ſtrout in the belly, that it may be felt by the hand, and ſometimes being empty, it is in Diſſections hardly diſcerned at firſt, by reaſon of its ſmallneſs, being no bigger than a large Pear.

Its Magnitude.

Its Figure is long-round and globous, that it may hold the more: And it hath within one Cavity, ſeldom two, diſtinguiſhed by a Membrane as a partition wall. Such were found in a Maid of thirty five years old, by *Voltherus Coiter*, and *Casparus Bauhinus*, and *Raphael Thorius*, and *Brouardus*, have deſcribed unto us the like which they found in the body of the great *Casaubon*, the one of which being the left and præternatural, had a paſſage into the right by a round hole, which would admit the tops of four fingers, being full of the urin, which at ſet times, and its uſual endeavor, it voided by the right Cavity, which was ſix times as great as it, being continued thereunto, with as many Membranes thick, and common to the reſt of the greater bladder. This double Cavity in theſe and the like, is not formed of the dilatation of the Ureter, within the foldings of the bladder, which may nevertheleſs often happen, but in *Casaubon* each Ureter did end in the bladder, and that it was originally ſo, the ſaid perſons demonſtrated. e. It being the pleaſure of nature.

The Situation of the Piſſ-bladder.

Its Figure.

The FIGURES

Explained.

This TABLE expresses the Coats of the Bladder, as also the Seed-bladders seated in the Hinder-part thereof.

FIG. I.

- AA. The common Coat of the Bladder.
 BBB. Its middle Coat, furnished with muscularous Fibres.
 C. Its inmost wrinkled Coat.
 DD. The Neck of the Bladder.
 E. The Sphincter Muscle of the Bladder.
 FF. The Kernels called Prostate.
 GG. A Portion of the Ureters.
 hh. Their Inflection between the two Coats of the Bladder.

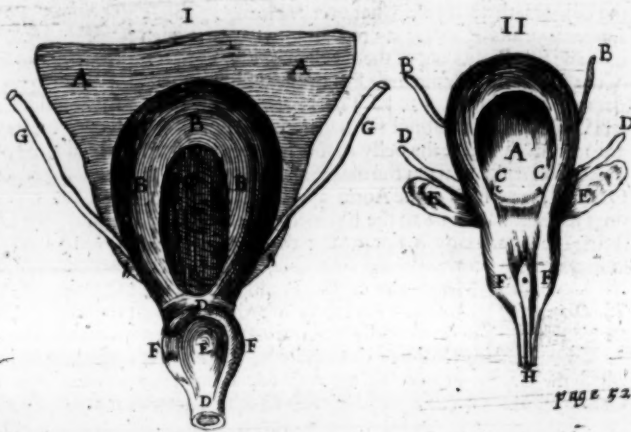
FIG. II.

- A. The inner Coat of the Bladder being opened.
 BB. Part of the Ureters.
 CC. The Orifices of the Ureters widened in the Bladder.
 DD. A Portion of the Vasa deferentia, or carrying Vessels.
 EE. The Seminal Bladders disflaid.
 FF. The Kernels called Prostate divided.
 G. An Hole going from the Bladders into the beginning of the Piss-pipe, furnished with a Valve.
 H. The common Passage of Piss and Seed.

FIG. III.

- A. The Hinder side of the Bladder, with its External Coat taken off.
 BB. The Ureters.
 CC. A Portion of the Vessels which carry away the Seed.
 DD. The Seed-cases, or Capsulae Seminales.
 dd. Their End.
 EE. The Seed-bladders expressing divers Cells.
 FF. The Kernels called Prostate.
 G. The Piss-pipe.

The XXI. TABLE



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ture, that as his mind was above that of other Mortals, so the unusual structure of his body, should afford like admiration to Posterity. From the bottom, it is by little and little strained into a narrow neck, whence arise two parts of the Bladder, The Bottom and the Neck.

Its Connexion. The Bottom is fastned to the Peritonæum, also to the Navil, by an intermediate Ligament, called Urachus, and the two Navil-arteries dried up, least when a man walks upright, the bottom should rest upon the Neck. Hence is the Sympathy between the neck of the bladder and the Navil. The neck of the bladder is fastned in Women to the Neck of the Womb, and the neighboring Hip-bones; in Men to the Rectum Intestinum.

Its Substance. Its Substance for strength is partly membranous because of extension, and partly

ly fleshy, because of motion. For it hath two Membranes, and one Muscle infolding the whole bladder, which all other Anatomists except Aquapendente, do make to be a third Membrane, and not a Muscle.

The first Membrane is outmost and common, from the Peritonæum, strong Membranes, and thick.

The other is inmost, and proper, thin, of exquisite sense, interwoven with all kind of Fibres, that it may admit of much distention and contraction [wherein there are very many wrinkles, in persons troubled with the stone, and little cavities are engraven which hold stones, being caused through long want of distention] And it is covered with a fleshy Crust, or wrinkled Coar as it were, made of the Excrements of the digestion, least the innermost Coat should be fretted

The Crust of the Bladder.

stitted by the sharpness of the Urine.

That which is in the middle, betwixt this proper and the outmost Coat, is by others called the second proper Membrane, which nevertheless they grant to be thick, and furnished with fleshy Fibres.

The expulsive Muscle of the Bladder. But it is rather a Muscle encompassing the whole Bladder: because it hath Fibres visibly fleshy, inserted into the beginning of the bladder: So that, as the circular Muscle called Sphincter, does

close the bladder, that our water may not pass from us against our wills, so this Muscle does help the voidance of our water, whilst by contracting it self, it squeezes the bladder. And this is, indeed, the Opinion of my Master *Aguapendent*; the truth whereof *Waleus* was wont thus to prove in the Dissection of live Dogs: having cut off all the Muscles of the Abdomen, he makes a small piercing wound into the bladder, out of which wound or hole, the urin spins out as far, as naturally it does from the Yard: yet I shal not refuse to grant thus much to other Authors: VIZ. that the Muscles of the Abdomen or Belly, do also help forward the Expulsion of Urin. It makes nothing against us, that the stomach, and Guts, and Womb, have the like fleshy membrane; for they also did need such an one, that they might more easily be widened and contracted. Hence, though the Membrane of the Bladder be more fleshy, yet in a large sense, the Membrane of these other parts may likewise be termed muscularous. But the condition of Spirituous blood, forcibly issuing forth, and of a dull and lazie urin are different. Moreover, in the Veins, the precedent blood is forced on by that which follows, according to the Laws of Circulation, and the inbred Faculty.

Its Holes. The Bladder hath three Holes: Two a little before the Neck, where the Ureters are inserted, of which before, the third is in the Neck, to let out the Urin.

Its Neck. Now the Neck of the Bladder, is its narrower part, through which the Urin is voided. In Men this Neck is more long-round, narrow, and a little writhen, because being placed under the bodies which compose the Yard, it is carried upwards, under the Share-bones, from the Fundament to the Original of the Yard: To which in the hinder part two Kernels are adjoynd, called the *Prostate*. In Women the Neck of the Bladder is short and broad, stretched forth-right downwards, and implanted above into the Neck of their Womb. In both Sexes the Neck is fleshy (which therefore heals, being wounded, whereas wounds in other parts of the bladder are deadly) interwoven with very many Fibres, especially such as run athwart, which purse up the Neck of the bladder, that

The Sphincter Muscle. our water may not pass from us against our wills, and this orbicular Muscle is therefore called the *Sphincter*. Which if it be over cooled, or troubled with the Palsie, or any other Disease, the Patient cannot hold his water.

Its Vessels. The Bladder hath Veins, termed *Vene Hypogastricae*, implanted into the sides of its Neck, which being variously distributed through the bladder, are mutually conjoynd one with another, and with the Arteries, and are penetrable by mutual holes from one to another, so that the blood may easily pass out of one branch into another, according to the Observation of *Sylvius*, that the nutritive blood brought in by the Arteries, may return by the Veins. Now the reason why the Bladder hath Veins, is, because it draws a meer Excrement, viz. the Urin, which it cannot be nourished.

It hath Arteries from the Hypogastrica in Men, in Women from the Vessels which go into the Neck of the Womb.

It hath considerable Nerves from the sixth pare, and from the Medulla of Os sacrum.

Its Use is, to contain Urin, and to be the Bodies Chamber-pot; also Stones it contains and Gravel, and sometimes other things, as Hairs, Witness *Galen*, *Donatus*, *Hallerius*, *Shenkius*, *Tulpius*; Worms, by report of *Hallerius*, *Mindanella*, *Dodonaeus*, of which there was a late Instance at *Hafnia*, Pinns, and which is most strange, Pot-herbs, according to the late Observation of *John van Horn*. And its next use is to expel the said Urin contained.

Chap. XXI. Of the Seed-preparatory Vessels in Men.

Hitherto we have handled the Organs of Nutrition; those of Procreation or Generation come next to be spoken of, which are different in Men from those in Women. In Men those which first present themselves, are

The twofold Spermatick Vessels, viz. The two Spermatick Veins, and the two Spermatick Arteries. *The Spermatick Vessels and their Original.*

The right hand Vein, arises from the Trunk of *Vena cava*, a little below the Rise of the Emulgent: The left springs from the Emulgent, for otherwise it should go over the Aorta, and there would be danger of breaking, or rather least by the Pulse of the Artery, the motion of the blood in the Vein, should be in some sort stopped and hindered. Therefore it hath its Rise seldom from the *Cava*, and sometimes from both places.

Both the Seminal Arteries do arise from the *Arteria magna*, or great Artery: Almost two fingers breadths distance from the Emulgents.

These Vessels are in Men greater than in Women; and the Arteries are larger then the Veins, because very much Heat, and Vital Spirit, and Arterial blood are requisite, for to make the Seed. Sometimes one Artery is wanting, and sometimes both, peradventure in such as cannot ingender.

These Vessels are somewhat distant one from the other; they are obliquely carried above the Ureters to the Groyns, but in their progress, these Veins and Arteries are joynd by infinite Anastomoses (so that the Arteries are so coupled within the Coat of the Veins, as if they were but one Vessel) and they are knit together by a Membrane arising from the Peritonæum, and are afterwards carried to the beginning of the Stone, like the tendrils of a Vine, being so interwoven, that a curious eye cannot distinguish a Vein from an Artery.

And this Intertexture of Veins and Arteries thus made, is by some called *Corpus varicosum*, *varicosum*, *pampiniform*, *Pyramidal*, &c. which others do thus distinguish: Where the preparatory Vessels do from a narrow beginning, first widen themselves into a broader Basis, they are termed *Pyramidalia*. And when afterward before their entrance into the Stones, they become here and there crisped like the Tendril of a Vine, they are called *Pampiniformia*. Howbeit the Vessels do not pass through but are carried between

The FIGURE explained.

This TABLE comprehends the Kidneys, Bladder, Yard, and Seminary Vessels, as they are wont to be shewed, taken out of the Body.

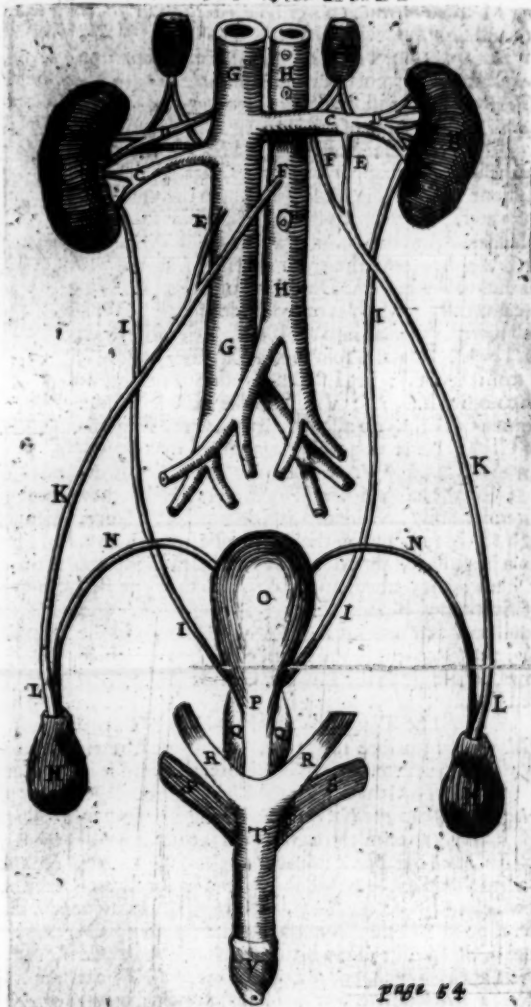
- AA. The Auxiliary Kidneys, or Deputy-kidneys.
- BB. The true Kidneys.
- CC. The Emulgent Veins.
- DD. The Emulgent Arteries.
- EE. The Spermatick Veins.
- FF. The Spermatick Arteries.
- GG. The trunk of Vena cava, divided into the Iliack Branches.
- HH. The trunk of the great Artery, divided in like manner.
- III. The Ureters.
- KK. The Vessels which prepare the Seed.
- LL. The same Vessels where they make the Vasa pampiniformia.
- MM. The Stones covered with all their Coats.
- NN. The Vessels which carry away the Seed going behind the Bladder.
- O. The Piss-bladder.
- P. The Neck of the said Bladder.
- QQ. The Kernels called Prostatæ.
- RR. The Muscles which raise the Yard.
- SS. Two other Muscles which widen the Piss-pipe.
- T. The Body of the Yard.
- V. The Fore-skin covering the Nut of the Yard.

its double Coat, with a small Nerve, from the sixth Conjugation, and the Muscle Cremaster.

These Preparatory Vessels of Generation, when they come unto the Stone, are not changed into the carrying Vessels, as if one continued body with them as many imagine. But they pierce through the proper Coat of the Stone, and are spread through the substance thereof, and so obliterated.

Their Use. The use of the Spermatick Arteries, is to carry Blood and Spirit to the Stones, and in those various interweavings to prepare the same, by a virtue which they fetch from the stones, by reason of its long stay and accurate Concoction, and sitting in those crooked Mazes, that it may become Seed; and may nourish the Stones, for which nourishments sake, in those that are not yet of ripe age, these Arteries carry blood, before they can labor and make Seed. Now the use of the Spermatick Veins, closely interwoven with the Arteries about the Stones, and joynd to them by mutual Anastomoses, is, to carry back that blood which remains superfluous, after the Stones are nourished, and the Seed made, unto the left Emulgent, or to the Vena cava immediately, on the right side, where the Seed is commonly propagated from thence.

The XXII. TABLE.



feared, least this return of the blood through the Veins should withdraw matter from the Seed, or that the generating Spirit should return upwards from the Stones. For by reason of the intricate mixture and intertexture of the Vessels, no part goes back, save what the stones dismiss, as not necessary for themselves, nor the whole Body. And therefore we do for the most part find the Arteries which bring the blood greater, and the Veins which carry it back lesser, because the Stones do not return so much as they receive. And that the Spirit is retained, the silent course of the blood through the Veins, is a token. Which blood, verily, is retained in the stones from flowing back, by the same power whereby it is retained in other Parts of the Body.

CHAP. XXII. Concerning the Stones.

The Stones or Testicles so called, as witnessing the courage and strength of a man,

man, without which a man was no sufficient witness in the Roman Court, are also called *Didymoi* or *Gemelli* Twins, because commonly

Their Number. They are in Number two. Seldom one great one and no more, as in *Sylla* and *Cotta*, Witness *Arrianus*; seldom three, as in *Agathocles* the Tyrant of *Sicilie*, and some Families of *Italy* of the *Colci*, especially at *Bergoma*, and others at *Parù*, according to the Observation of *Fernelius*, which is also proper to a renowned Family in *Germany*; and four, which *Aristotle* partly observed, and *Riolanus* the Father, so small that they proved barren, because either they do not sufficiently digest the matter of Seed, or they do not easily receive the same, because of the straitness of their passages.

Why placed without in Men? They are seated externally in Men, without the Abdomen, under the Belly, at the Root of the Yard, in their Cod or Covering. 1. For Chastities sake, if we believe *Aristotle*. For such live-wights as

have their Stones hid within their Body, are very lecherous, do often couple, and get many young ones. 2. That by reason of the longer passage, the greater stay of the Seminal matter, may cause the better preparation. 3. *Laurembergius* would have them nearer that external place wherein they were to generate, viz. the Womb. But that nearness, doubtless, helps nothing to Generation, though the nearness of the Yard does: Nor do we find this observed in many Animals which generate out of themselves.

That the Stones have lain hid in the Cavity of the Abdomen, until Puberty or Ripeness of Age fit for Generation, *Martinus Rulandus* proves in two Histories, *Pareus* in one, and *Riolanus* in a story not unlike. In which kind of persons, if the Yard should also lie hid, we should ever and anon have an appearing change of Sexes.

The *Epididymides* rest athwart upon the Stones, and compass them as it were, being a kind of little Stones, oblong, round, white, and wreathed, but at both ends, somewhat sharp, of which see the following Chapter.

Their Greatness. Their Magnitude in men does commonly answer that of a small Hens Eg. And in men the Stones are greater then in women.

Their Figure. The Figure of the Stones is Oval. Which Figure varies sometimes, by reason of the neighboring Vessels more or less turgent: And therefore some say the right Testicle is more full vein'd, and it is thought to be more hot, and have seed better digested. Whence *Hippocrates* calls it the Boy-getter, because it receives more pure and hot blood

Whether the left Stone be colder then the right. and Spirits out of the great Vessel, viz. the great Artery. The left Stone is thought to contain colder Seed, more wheyish and weak, because for the most part, the matter is believed to be brought from the Emulgent, and therefore *Hippocrates* calls this Stone the Girl-getter. Whence that common Saying, Wenches are begot by the left Stone in the left side of the Womb; Boys by the right Stone in the right side. And *Hippocrates* saies, there is in a man as well as in a woman both male and female Seed, that is to say, hotter and colder. But I am not of Opinion, that wenches are alwaies begotten by the left Stone, and that it receives a colder sort of Seed, for, 1. There are ever and anon *Virago's* or manly Women, which exceed Men in strength and courage. 2. Blood is communicated from the great Artery, as well to the left Stone as

to the right. 3. The *Asteria Spermatica* is oftner wanting on the right side then on the left. But the Generation of the frailer Sex, depends not so much upon the coldness of the left Testicle, as upon the cold Constitution of both the Stones, or rather of the whole body, which administers Matter for the Seed. Howbeit the left parts of the body are generally said to be colder then the right.

Moreover the right Stone is fuller of Seed, doth swell more, and hath a greater Vein and Artery, so that Nature seems to design the Generation of Females more then of Males. It was therefore ill said of *Aristotle*, that Nature of her self did alwaies intend the Generation of Males, as being most perfect, and that a Female is ingendred, when Nature being hindered, could not ingender a Male, so that a Woman is in his account a kind of Monster in Nature. Howbeit Nature seems more sollicitous for the Generation of Women then of Men, for the Causes aforesaid, nor does Nature alwaies regard that which is best or most perfect, but that which is most necessary, as a woman is: For many of them are but enough for one man. For women when they are big with Child, are useles to a man; also they are short lived, nor can they bear so long, as a man can beget. But of this, I have discoursed more fully, in my 12. Anatomical Controversie de partibus.

The Testicles have Coats and Coverings, some proper, others common.

They have two Coats common to them and other parts, to defend them from external injuries.

The first is formed of a thinner skin and scarf-skin, then is to be found in other parts of the Body, and is called *Scrotum* or *Scortum*, hanging out like a purse or bag, and subject to the touch. It is soft and wrinkled, void of Fat, that it might be more easily extended and wrinkled together: because the oylie matter which should make Fat, goes into the Stones to make Seed. In the lower part it hath a line running out according to the length thereof, which divides it into a right and left part, and is called a suture or seam.

The second Coat consists of a fleshy Pannicle, which is also thinner then is found in other places, full of Veins and Arteries, and called *dartos*. Which Covering is by others comprehended under the term *Scrotum*.

The proper Coat or Coverings, which on either side do cloath each Stone are three.

The first proper Coat is called *Vaginalis* the scabberd Coat, and by some *Helicoides*, by reason of its shape, which is thin, but yet strong, full of Veins, arising from the processes of the Peritonæum. It cleaves to the *Dartos*, by many membranous Fibres, which others have reckoned for a peculiar Coat. Whence it is externally rough, internally smooth.

The second is termed *Eruthroides* the red Coat, being furnished with some fleshy Fibres, bred out of the Cremaster, and inwardly spread over the former. *Rufus* names this in the first place, and *Riolanus* and *Veslingus* following him, account it the first Coat, because it compasses the former, and is propagated from the Cremaster.

The third last and lowest, immediately encompassing the substance of the Stone, and is as it were binding the same, is termed *Albuginea*, and by some *Nervæ*, because

The Error of Aristotle.

Whether Nature alwaies intends to beget Boys.

Their Coats.

Common.

The Cod.

Why void of Fat.

Proper.

The Explication of the FIGURES.

The Coats of the Stones, their Substance, and Vessels are propounded in this TABLE.

FIG. I.

- AA. The Skin of the Cod separated.
- BBB. The fleshy Membrane which is here called Dartos.
- CC. The first Coat of the Stones called Elythroides.
- DD. The Muscle Cremaster.
- E. The second Coat of the Stones, which the Author calls Erythroides.
- FF. The Coat of the Stones called Albuginea.
- G. The kernelly Substance of the Stone.
- H. The Pyramidal or Pampini-form Vessel.
- II. Epididymus.
- DD. The Parastates variciformis.

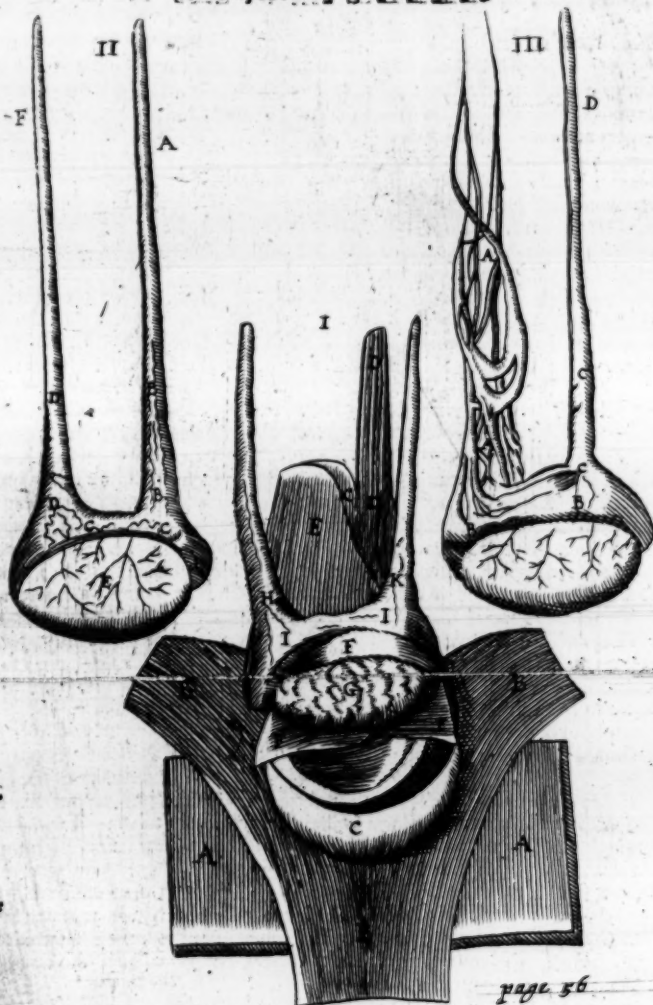
FIG. II.

- A. A Portion of the preparatory Vessels.
- BB. The Pyramidal Vessel.
- CC. Epididymus.
- DD. Parastates variciformis.
- E. The Stone covered with its proper Membrane.
- F. A Portion of the Vas deferens.

FIG. III.

- AA. The Veins and Arteries in the Pyramidal Vessel laid open.
- B. The Epididymus.
- CC. The Parastates variciformis.
- D. The Vas deferens.

The XXIII. TABLE.



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because it is white, thick, and strong, arising from the Coat of the Seminal Vessels.

The Substance of the Stones.

Vessels.

The Substance of the Stones is glandulous, white, soft, loose and spongy, by reason of very many Vessels there dispersed and loose, though without Cavity, as the Liver also and the Spleen have no Cavities. They have Vessels of all kinds. Veins and Arteries from the Seminary Vessels: An indifferent large Nerve from the sixth pair; sometimes also they have two Nerves from the one and twentieth pair of the Spinal Marrow, conjoined to the Seminal Vessels, carried with them through the production of the Peritonæum, and disseminated into the Tunicles.

Muscles.

They have on each side one Muscle, arising from a strong Ligament, which is in the Share-bone, where the transverse Muscles of the Belly end, of which they seem to go along through the production of the Peritonæum, which they compass about well-near the beginnings of the Stones. They are called Cremaster.

or Suspensores, hangers or sustainers, for they hold up the Stones, that they may not too much draw down the Seminal Vessels. Also in the Carnal conjunction, they draw back the Stones, that the Seed-channel being shortened, the Sperm may be sooner and easier conveyed into the Womb. In some persons these Muscles are capable of voluntary motion, who can draw up, and let down their Stones as they list: where these Muscles are doublets stronger than ordinary, that they may not only hold the Stones suspended, but move them from place to place.

The Use of the Stones is, by their Heat and inbred Faculty, to make seed. For the Efficient cause of Seed is the proper flesh or substance of the Stones,

The Efficient cause of the Seed.

both in regard of their hot and moist temper of their specifick Property; since no flesh in the Body is found like that of the Stones. Now they turn the blood being prepared into Seed, which is requisite to preserve the Species of Mankind: And that which remains over and above, either goes back by the Spermatick Veins into the Heart, or turns to nourishment for the Stones.

Without the
Stones there
is no Gene-
ration.

Stones. Nor can Seed be ordinarily bred without the Stones, nor perfect Animals without them, for from them the Seed receives both its form and colour.

That some have ingendred without Stones, though not according to the ordinary Course of Nature, *Smectius* in his Miscellanies, *Fontanus* in his Physica, *Cabrolusius*, *Hofmannus de Generatione*, and others, do testifie. Now the place wherein the Seed is bred, is not any large Cavity in the Stone, but certain very small Vessels therein formed, covered with a very delicate thin Coat, as *Vesalius* rightly teaches. Now these following Authors after *Aristotle*, have taken away the faculty of Seed-making from the Stones, viz. *Fallopius*, *Cabrolusius*, *Posthius*, *Casparus Hofmannus*, *Cesar Cremoninus*, *Adrianus Spigelius*, *Regius*, and others, because the Matter of Seed does not go into the Stones, nor is there ever any Seed found in them. But they will have them principally to be Receptacles for the wheyish Humeur which flows in with the Blood; which they collect from their glandulous substance, and the largeness of the left Stone. But they are confuted by Eunuchs and gelded persons, whose Stones being cut out or bruised, they become unable to engender. Also Seed hath been frequently observed in the Stones. Witness *Dodonæus* in his 39. Observation touching a Spanish Soldier, *Hofman de Generatione* Chap. 18. *Carpus* and *Riolanus*. It is indeed not to be found in some Bodies, because it was not bred, by reason of some sickness, or Imprisonment, or upon Death the Spirits being dissipated, a watry Liquor appears instead thereof. Nor can the Seed come to the *Vasa deferentia* otherwise than by the Testicles, which begin at the Stones, as the preparatory Vessels end in them, by the Observation of very many Anatomists, and why the left Stone is greater than the right, another reason is alleaged by learned men.

The Sympathy
of the Stones
with the whole
Body,

Also the Stones seems to give strength and courage to Mens bodies, as may be seen in gelded persons, who are changed well-near into Women, in their Habit of Body, Temperament, Manners, &c. And doubtless the stones

do exceedingly sympathize with the upper Parts of the Body, especially with the Heart. For we see that cordial and cooling Epithems in fainting Fits and bleeding at the Nose, being applied to the Stones, do help as if they were applied to the very Heart and Part affected. The Cause hereof is hard to tell; *Jacbinus*, *Laurentius*, *Hofmannus*, conceive that it comes to pass by reason of Passions of the Mind, which are joyned with fleshly Lust. But Eunuchs also are lustful, for they are great Lovers of Women: And Eunuchs are often transported with anger and other Passions of the Mind, but they receive not never the more the Habit of Men. *Galen* seems to have been of Opinion, that a Spirit was bred in the Stones and diffused thence al the Body over. But glandulous Bodies of the number of which the Stones are, are unfit to engender an hot Spirit; nor are there any Passages about the Stones, for the distribution of that new Spirit, according to the Opinion of *Galen*. Nor is therefore the Opinion of *Mercatus* allowable, viz. that those Spirits are not indeed bred there; but that the Vital Spirits are collected in the Stones in great quantity, that from them they may return back into the whole Body; for those which are there collected, are collected to engender Seed. But the Opinion of *Thomas a Vega* does better please me, till I shall find a more probable, viz. that a Seminal Air is raised up in the Generation of Seed, which thus

changes the whole Body. The flesh truly of ungent Creatures, hath a rammyish tast of the Seed, which the flesh of such as are gelt hath not. This Vapor or Air of the Seed is carried to the Heart, either by the inner Pores of the Body, or by the Veins which reconveigh to the Heart the superfluities of the generated Seed. *Helmont* imagines the Stones do act by a ruling power, at a distance, as the stomach does upon the Womb, the Womb upon the upper Parts, and that without any right waies or marks; which nevertheless an Anatomist seeks to find, if it be possible. *Veslingius* ingeniously makes the reason of the change of voice, temperament, strength, &c. in persons guelled, to be the oppression of their inbred Heat by plenty of Matter, which ought to turn to Seed. Now their Sympathy with the Heart, depends partly upon the Nerves, partly (for we hold the Circulation in the Stones) from the foresaid Veins, returning back to the Heart, by which both the vertues of Cordials ascend, and of cooling Medicaments, even as we apply Cordials and Coolers to the Hands, with like success.

Chap. XXIII. Of the Vasa deferentia, the Ejaculatoria, the Parastatae, Seminal Bladders, and the Prostatae.

WE have propounded the Spermatick preparatory Vessels above, which end into the Stones, to which they carry Matter to make Seed.

Now there are other Vessels, which begin at the Stones, and end at the Root of the Yard, whither they carry and there squirt out the Seed, which hath been made in the Stones: And these are termed *Vasa deferentia*, or Vessels that carry away the Seed; and they are two in number, on each side one.

Now we divide these Vessels into the Beginning, Middle, and End.

The Beginning are termed *Parastatae*. The *Parastatae*, as if you would say idle attenders upon the stones, ceremonious waiters, also *Corpora varicosa* or *variciformia*, because they are twisted and wreathed, like those crooked black Veins called *Varices*. *Galen* in his Interpretation of hard words used by *Hippocrates* calls them *Epididymides*, because they rest upon the stones, which nevertheless others distinguish by a peculiar use, as that they prepare the seed; and the *Parastatae* do add more perfection thereto: Others invert the Matter, and perswade themselves that the *Parastatae* prepare the seed, and the *Epididymides* finish it, which Opinion of theirs they have received; I know not how well, from the ancient Physicians. And they are oblong Vessels, placed upon the stones, white, thick, and round, a little depressed, and solid, growing narrow by little and little.

As for their Substance, tis of a middle nature betwixt that of the stones and that of the *Vasa deferentia*. For their substance is softer then the latter, and harder then the former, because they are glandulous within, and fungous; and externally membranous.

As to their Original, the Opinion of *Spigelius* and other late Anatomists, does against all former Authority thus determine; viz. that they

they arise by continuation from the Seminary Vessels, so that both the Præparatory Vessels, and the Paraſtata, and the Out-carrying Vessels, are but one continued Body, receiving divers Names according to its different Parts, and their respective Offices and Situations.

But *Waleus* conceives, that it is more suitable to what appears in Dissection, to say, that these Vessels do not arise from the Præparatory Vessels, but are rather mixed with them, fastned to, and opened into them: and that as he supposes, to the end that the blood forced in by the Præparatory Vessels, may deposite that Matter which it contains fit to breed seed, into the little branches of the *Vasa deferentia*. But the rest of the blood, which is unfit for Nutrition and Generation of Seed, is by other Anaſtomoses shed into the Veins, and by Circulation returns to the Heart.

Now they have their Original from the stones. by means of innumerable small Pipes or white Fibres. And there is no communion at all between the Vessel that carries away the Seed, and the Veins, and Arteries of the stones, which *Vesalius* conceives to be apparent in Dissections. Yet are they fastned to the inmost Coat of the stones, though they have a proper Coat of their own.

The Use of the Paraſtata, is to perfect their Use. and finish the seed, by a power which they receive from the stones. Moreover, while the seed abides in them, it comes to pass that vehement and frequent Lust is not provoked.

The Ejaculatory or squirting Vessels, are simply termed the Middle, because they carry seed from the stones and the *Corpora varicosa*, to the seminal bladders: for they are seen to carry a whiteish Humor, yea and the Paraſtata are frequently found full of seed.

They have a Substance white and nervous; and their Figure is round and long: They have an obscure Cavity, because the seed by means of the spirits whereof it is full, does easily pass.

Their Situation is partly in the Groin, partly in the Cavity of the Belly, above the Os pubis or Share-bone. For they are carried upwards, and are knit to the Præparatory Vessels, by a thin Membrane, and so pass along to the Flanks and the Share-bone, which for that cause have a slight Cavity. And afterwards being turned back downwards, they are carried above the Ureters, and under the hinder part of the Bladder, above the *rectum Intestinum*, they are on each side widened at the Neck of the Bladder, where

Their End is, and these Vessels so widened do constitute

The Seminary Bladders, which are many in number like little Cells, and seem to make on each side one remarkable, great, and winding one, because one goes into another, which you cannot compare to any thing better then to a bunch of Grapes. The Cavities do neatly represent the Cells of a Pomegranate in order and figure. *Rondelenius* did first of all describe these Bladders, and after him *Fallopium*. These nervous Bladders are seated between the Ligaments of the Piss-bladder and the Arse-gut, by the sides of the deferent Vessels, a little before the said Vessels grow thick, and unite.

Their Use is, to contain the seed being wrought, and to reserve the same till time of Copulation, so that there may be seed sufficient to beget many Children. And

therefore that is no wonder which *Aristotle* relates of a Bull that engendered after his stones were cut off: Whether a Bull may engender after he is castrated.

though others attribute this effect to the Prostate, as *Archangelus* and *Columbus*. Now the seed may be contained in these Cells many months together, and in regard of the multitude of these little Bladders, seed may be voided in many Acts of Copulation; and all not spent at one Essay.

And that seed is contained in these little Bladder-kies, besides the Authority of *Fallopium*, *Platerus*, *Laurentius*, *Aquapendens*, and *Cassorius*, it is manifest by this Experiment: If you squeeze them, presently seed is forced into the Pipe of the Yard, just like Milk out of the Dug, or piss out of the Piss-bladder, &c. But if you press the Prostate with your finger, yet nothing comes away, unless you press the Bladders also. And that the seed does not continually distil and drop out of them, into Urinary passage, a little Caruncleinders, which stops their hole, The perpetual seat of a virulent Gonorrhæa, hath been by the Observation of late Anatomists found to be in these Bladders, for upon Dissection there hath been found an evident Impoſthumation in these parts. From the situation of these Bladders and of the stones, without the Cavity of the Abdomen, *Riolanus* would give a reason why men are not so cruelly infected with the filthy vapors of corrupt seed, as women are. But the Peritonæum does not hinder the evaporations of the seed, because the Veins do inwardly open upwards. Also Viragoes or mannish women, are not troubled with the said vapors. The reason must therefore be sought in the quality of the seed, which being in men and manly women more benigne, does neither go to, nor infect the Heart.

After the Constitution of the seminary Bladders these deferent Vessels are united into one final passage which goes into the Prostate.

Now the Prostate, as if you would say the Waiters, are two See Tab. XXII. Let. QQ. Kernels, manifestly differing from the seed bladders, in use, form, situation, and magnitude, though *Hofman* think otherwise; their

Situation is at the Root of the Yard, above the Sphincter or Muscle of the Bladder, on each side, at the neck thereof. *Columbus* calls them Prostate, *Vesalius glandulosum corpus*, *Fallopium glandulosum assensum*, others call them the little stones, to difference them from the true stones. Before and behind they are flat, on the sides round.

They are commonly as big as a Walnut.

Their Substance is spongy, and yet harder and whiter then that of other Kernels, and they are covered with a thicker Membrane; all which is to hinder the oylie substance, of it self apt to run, from passing out. And because they are of exquisite sense, therefore they cause pleasure in Copulation. These Kernels are open by certain Pores into the Uræthra or Piss-pipe, which is evidently apparent in such as have died of the Gonorrhæa, of which Gonorrhæa these Pores being dilated are many times the seat.

Their Use is to contain an oylie, slippery, and fat Humor, which is pressed forth when need requires, to daub the Urinary passage, to defend it from the acrimony of the seed or urin, and that it may not fall in through driness, but may remain slippery; because through it in Copulation, the said Humor does suddenly flow out of the seed.

This is that which *Galen* ment, when he said that they contained a certain Humor like seed, but much thinner, the use of which Humor, is to excite Lust, and

and to cause Delight in Carnal Copulation.

Whether the Prostate do make seed. Mean while, *Spigelius*, *Riolanus*, and others do conceive that they contain seed, which is there collected, and thence voided, having attained some further perfection, as *Veslingus* conceives. Others as *Laurentius*, conceive they do both; for he will have the Prostate both to thicken the seed, and to breed a thin humor, and excite titillation. But that they do not contain seed, their compression shews, which voides none, unless the Vesicles or seed-bladders be withal compressed.

The seat of the Gonorrhæa.

And seeing the seat of the Gonorrhæa is here, which we frequently observe to continue many years, without any remarkable Detriment to Health, it is unlikely that the seed flows from the Prostate. I saw a man at Padua, who was troubled thirty years with the Gonorrhæa, and hath it still, being otherwise in Health. The seed therefore is not contained in them, nor does it stay there, though it may pass through.

The Prostate do not help to make seed.

Others do conceive, that they help to make the seed, yea that they and the bladders are the only seed-makers, as *Regius* endeavors to prove. Which if it were true, goulded persons might engender. Goulded persons do indeed send forth a moist matter resembling seed, and they are provoked to Venerie, but they can get no Children. And if they have been observed at any time to engender, according to what is related of goulded Horses and Bulls; there was doubtless remaining in the seed-bladders, so much seed made by the stones, as might serve for one bout of Generation. But if they engendered more then once, doubtless one stone was left behind, when they were goulded.

Chap. XXIV. Of the Yard.

Its Name. The Genital Member of a Man is commonly called in Latin *Penis a pendendo*, because it hangs, also *Virga* the Rod or Yard, *Colis*, &c. Many other Names are wont to be put upon it, which are better past over then mentioned. In English tis most usually termed the Yard or Prick. *Plato* in his *Timæus* compares it to a certain living Creature, because it hath an Appetite to Generation. Howbeit, it is indeed the Part and Instrument of a Live-wight, and the Faculty of Appetite is seated in the Brain.

Situation. Tis seated at the Roots of *Os pubis*, that carnal Copulation might more conveniently be accomplished, and that it might be no impediment to other parts: it is placed in the middle, because only one in number. Yet there was once a man dissected at *Bonomia* who had two Yards. Which also *Obsequens* relates of a Boy, among his Prodigies. Another named *Anna*, being lately a vagrant in *Italy*, had no Yard, but instead thereof a certain piece of spongy flesh under his Navil, which Nature had provided him to piss withal.

Figure. Its Figure is round and long; but not exactly, because it is broader on the upper side, which they call the Back of the Yard.

Magnitude. Its Magnitude consisting in thickness and length, does vary, both in the several sorts of Animals, and in the Individual Creatures of the same sort. Particularly, tis in Man so great as was necessary to propagate his species or kind: But proportionally shorter then in many Brutes, because Man-kind couples after another manner then those beasts do. In particular Men, there is exceeding great variety. For it is for the most part greater then ordinary.

1. In little Men. 2. In such as abstain from carnal Embracements, if we believe *Galen*. 3. If the Navil-strings be not tied close to the Navil in Infants; for otherwise, by reason of the Urachus or Piss-pipe, the Bladder and neighboring Parts, are drawn more upwards. Yet *Spigelius* is herein of a quite contrary mind. 4. In such as have large Noses. For the proportion of the Yard answers that of the Nose very much, if we will believe Physiognomists. 5. In Block-heads and dull-pated Asses. Some Nations have this Member larger then ordinary, as the *Æthiopians* or *Black-mores*.

It consists of the Scaff-skin, Skin, fleshy Membrane, and a proper substance of its own.

It is void of Fat, even in the fattest men. And it is a great question why there is no Fat found either in it or about it. Some, as *Laurentius*, think it is because fat through its softness would hinder its erection: But the Yard will stand, as long as the Bodies thereof are blown up. Others make the Cause to be least the weight thereof should do hurt, and that the Yard might not grow too great. But if there were a little Fat, it would add nothing to the weight, nor would it enlarge the Yard over much. The truer Cause therefore is this, that there is therefore no Fat, that its sense might not be dulled, and the pleasure of Copulation abated, when the Fat should melt by rubbing the Yard.

Its proper Substance is not bone as it is in a Dog, a Wolf, a Fox, a Whale, &c. but peculiar and proper to it self, such as is no where to be found in any other Part of the Body. Now there are four proper Parts of the Yard, the Urethra or Piss-pipe, the Nut, and the two nervous Bodies.

The URETHRA or Piss-pipe, is a nervous Pipe or Channel, always of the same size, from the neck of the bladder (to which it is joyned, but does not arise therefrom, nor communicate therewith) like a long neck, to the End of the Yard; save where the Nut is joyned with the nervous Bodies. For there indeed it hath a superficial Cavern or Hollownes, in which an Ulcer and intollerable pain does sometimes happen, when some corrosive humor is there collected, by means of a Gonorrhæa, or some other occasion. It is exceedingly widened in persons troubled with the stone. *Alpinus* saw it so wide in *Egypt*, that it would receive a large Hazel-nut. And therefore it is easily blown up, to draw out the stone.

In the beginning thereof are those Pores, through which we said before the seed stils forth. There is also a little Membrane or Caruncle like a Valve stretched before it, to keep the seed and urin from returning into the spermatick Vessels. It is eroded or fretted by sharp Humors, or by use of the Catheter, whence follows a perpetual Gonorrhæa. *Riolanus* observes that it is found in Boys, till the twentieth year of their Age, but I see no cause why it should not remain in their after Age, when the encrease of seed, makes it more necessary then formerly.

The Bodies of the Yard do embrace and touch this Urethra, and it is d back with them, and so reaches to the N is the figure of an S. Moreover th ath a double Membrane and a sub e also it self. One

Why the Yard is void of Fat, the first Opinion.

Laurentius his Error.

Its Substance.

The four Parts of the Yard.

Urethra.

The Explication of the FIGURES.

All the Parts of the Yard
are represented in this
TABLE.

FIG. I.

- AA. The inner Surface of the Urethra being dissected.
B. A Part of the Urethra which makes its way into the Nut.
CC. The Nut of the Yard.
DD. The two Nervous Bodies of the Yard.

FIG. II.

- A. The Membrane of the Nervous Body separated.
B. The blackish Pith of the said Body.
C. The Nut of the Yard made bare.

FIG. III.

- AAA. The inner Part of the Nervous Body, all the spongy Substance being taken out of it.
B. The Nerve which goes into the said Body.
CCC. The Artery of the said Body.
DD. The transparent Partition, by Spigelius so called.

FIG. IV.

- AAA. Veins running along the Back of the Yard.
BB. Arteries.
CC. The Nerves of the Yard.
D. The Nut of the Yard.

FIG. V. Shews the Muscles of the Yard in their places.

- AA. The Parts about the Buttocks.
B. The Region of the Shave.
C. The Yard with its Skin read off.
DD. The two Nervous Bodies.
E. The Urethra or Piss-pipe.
FF. Two Muscles which widen the Piss-pipe.
GG. Two Muscles which raise the Yard.
aa. Their Beginning cut off from the Hip-bone.
H. The Fundament.
I. The Sphincter Muscle of the Fundament.
KK. Two Muscles which draw up the Arse-gut.

One Membrane is internal and thin, of exquisite sense, as those can witness who are troubled with the stone. With which also the Nut is covered; and it is bred out of the thin Membrane, which cloaths the Nerves of the Yard. The other is external, more fleshy and furnished with transverse Nerves: The middle part of its proper substance, is loose, spongy, and black, that it may be distended together with the nervous Bodies.

The Use of the Urethra for the Urin, Seed, and o

mon passage

The XXIV. TABLE



The Nut or Head of the Yard, is the outmost swelling part thereof, roundish or pointed, even and compassed with a Circle like a Crown.

It hath *Flesh* more sensible and solid then the rest of the Yard, covered with an exceeding thin Membrane.

It is soft and of exquisite sense, for Titillations sake.

In some Men it is more sharp, in others more blunt.

It hath a Coat or Covering called the *Fore-skin*, or *Præputium a putando*, from cutting off, for the Jews and Turks cut it off, and therefore they are nick-nam'd A-

The Nut of the Yard.

pelle and *Recutiti*, skinless or skin-cut. In which Nations tis wonderful what *Veslingius* told me himself saw, viz. that in young Boys it grows out so long and pointed, that it resembles a tayl. *Hildanus* observed it in a certain person very great and fleshy. At the lower end it is tied to the Nut by a Membrane or Band termed *Frænum* the Bridle, which is terminated in the hole of the Nut. Some will have it to be made up of the extremities of the Nerves. *Carolus Stephanus* thinks it is composed of a Combination of the Tendons of the Muscles of the Yard, and a Nerve.

The two nervous Bodies, on each side one, do make up the remaining and greatest part of the Yard: the whole substance whereof is like a most thick spongy Artery, stuffed with flesh.

For the substance thereof is twofold, the first external, compact, hard, and nervous; the other internal, spongy, thin, and hollow, and of a dark-red colour inclining to black; and therefore *Vesalius* saies tis filled with a great deal of black Blood, like a Padding.

Now this substance is rare and pory, that it may be filled with Spirit, and Venal and Arterial Blood; by which means the nervous substance thereof is the more stretched, and the Spirits are not soon dissipated, whence proceeds the hardness and stiffness of the Yard, not to much for Copulations sake, as that the man might squirt his seed right out as far as might be, even to the Orifice of the Womb, after the Yard hath been moved in the female Privy.

These two Bodies have their Original from the lower parts of the Hip-bones, as from a firm and stable Foundation, to which they are strongly tied with two Ligaments; where in their Rise they keep some distance, that place may be allowed to the Urethra: and then they are carried upwards, and grow into one about the middle of the Share-bone (like the two horns of the letter y) but so as they do not both remain perfect, but they loose near a third part of their nervous substance. Howbeit they remain distinct, by the coming between of some membranous partition (which consists not of a double Membrane, as at the Rise of the Bodies, but of one single one) very thin and transparent, strengthened with nervous and strong transverse fibres; which fibres are ranked and ordered like a Weavers Comb.

All kind of Vessels enter into the Yard, Nerves, Veins, and Arteries. 1. External ones running in the Skin, very frequent, from the *Pudenda*, and also internal ones spread through its Body. They are therefore mistaken, that think the Yard is destitute of Veins. Its internal Arteries are two remarkable ones, arising from the *Hypogastrica*, which are inserted at the beginning of the growing together of the Bodies, and are spread up and down, according to the length of the Yard. But in the middle, where the Septum or partition is thinnest, they send branches up and down, through the spaces of the Fibres, the right Artery into the left Body, and the left Artery into the right Body, carrying Spirit and Blood, to blow up, erect, and nourish the Yard. The Nerves also are disseminated from the Marrow of *Os sacrum*, through the Yard, as well the external and Skin-nerves, as the internal, and those remarkable ones, which ascend through the middle of the forked division, and are thence disseminated into the Muscles, the whole Body, and the Nut; that there might be an exquisite sense and delectation.

Also the Yard hath two pare of Muscles. *The Muscles of the Yard.*

The first pare short and thick, are the Yard Erectors: this pare arises nervous, under the beginning of the Yard, from an Appendix of the Hip, and growing fleshy, it is carried to the bodies of the Yard, into which it is inserted, not far from their Original.

Their Use is to raise and keep the Yard up in Copulation.

The second Pare which widens the Urethra is longer, but thinner or leaner. These two fleshy Muscles arise from the Sphincter of the Fundament, following the length of the Yard: then they are carried beneath, and inserted into the sides of the Urethra, about the middle thereof.

Its Use is to widen the lower part of the Piss-pipe, both in pissing, and especially in Copulation, when the bodies of the Yard are full, that the Egress of the Seed may not be hindered. And in these Muscles is the place where Surgeons do commonly take out stones. The Line of the Cod being drawn to one side, according to their length, and not according to their breadth as *Marianus sanctus* notes against the Ancients, an hollow Catheter being thrust into the Ureter, upon which the Incision is to be made, which manner of cutting *Aquapendens* describes and approves of.

The Use of the Yard is for Copulation: on which a man cannot rightly perform without the Erection of his Yard, and the squirting out of the Seed which follows thereupon. For the man squirts his Seed right out into the Mouth of the Womb, where being afterward joyned with the womans Seed, an drawn in, and retained by the Womb, Conception is said to be made.

A secondary Use thereof is to void urin, yet was it not therefore made, seeing women do make water without it. By reason of this twofold use of the yard, the Arabians make two passages, as *Vesalius* tells us; who observed such a like Conformation in a certain person.

In some the Nut of their Yard is not bored through in the fore part where it ought to be, but in the lower part, as *Hofman* hath noted out of *Aristotle* and *Paulus*, who cannot make water if their Yard do not stand, or when they sit. Others, and that more frequently, have it imperforated in the upper part. They are both unsuit for Generation. Sometimes the Yard hath no passage at all as *Julius Obsequens* hath observed.

Chap. XXV. Of the Parts serving for Generation in Women, and first of the Spermatick Preparatory Vessels.

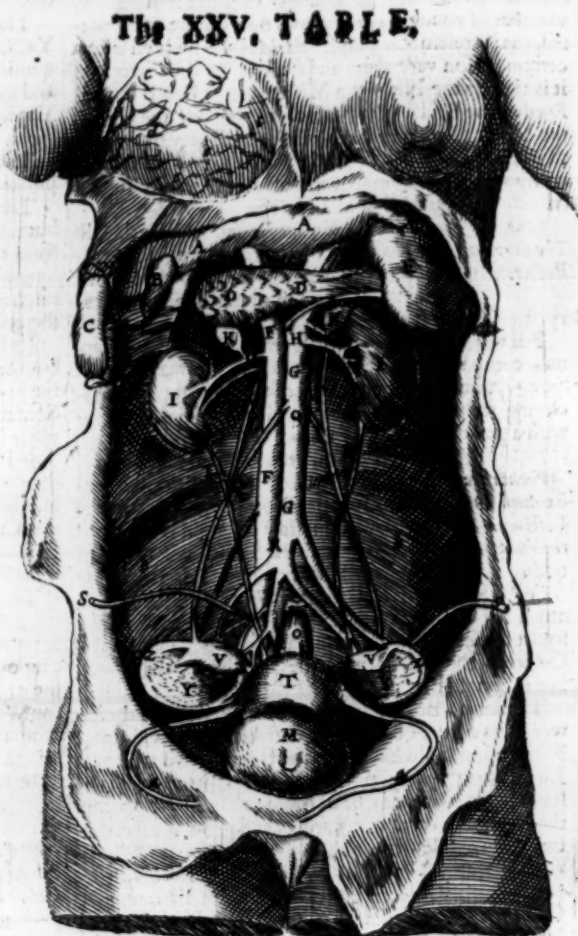
THE Parts serving for Generation in Women, do some of them agree after a sort with those in Men, as the Spermatick Vessels, the Stones, and the *Vasa deferentia*, or Vessels that carry away the Seed. Others are wholly different, as the Womb with its Bottom, Orifice, and Neck, the Hymen, the Mitle-shap'd Caruncles, the Vulva with its Wings, the Clitoris, and the little Hills.

The Genitals in Women quite different from those in men.

The Explication of the FIGURE.

The Parts which in Women serve for Generation are represented in this TABLE, in their Natural Order and Situation; also the internal Structure of a Womans Dug, is represented in the same TABLE.

- AA. The Liver in its proper Place.
 B. The Gall-bladder with the Porus biliaris or Gall-passage.
 C. A Part of the Gut Duodenum.
 DD. The Pancreas or Sweet-bread in its proper Situation, through which Vessels go into the Spleen.
 E. The Body of the Spleen.
 FF. The descendens Trunk of Vena cava with its Branchings.
 GG. The descendens Trunk of the great Artery, which is variously branched beneath.
 HH. The Emulgent Vessels.
 II. The true Kidneys.
 KK. The Auxiliary or Deputy Kidneys.
 LL. The Ureters going down to the Bladder.
 MM. The Bottom of the Piss-bladder.
 N. The Insertion of the Urachus into the bottom thereof.
 O. A Portion of the Arse-gut.
 PP. Preparatory Vessels from both sides.
 Q. The Rise of the Preparatory Vessels from the Trunk.
 R. The Place where the Trunks of the Cava and Aorta do branch themselves, where an Artery goes over a Vein.
 SS. Portions of the Navil-arteries.
 T. The Bottom of the Womb.
 VV. The Womans Stones.
 XX. Vessels which carry the Seed from their Stones to the Womb.
 ZZ. The Trumpets of the Womb, by Fallopius so called, or the blind Passage of the Seed.
 YY. The two upper Ligaments of the Womb, resembling the Wings of Batts or Flitter-mice.
 aa. The two lower Ligaments of the Womb, round, cut off from the Share.
 bb. The Hollow of the Flank-bone or Os Ilij, which is in Women larger then in Men.



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The Characters of the Dug explained.

- ccc. Vessels spread over the Surface of the Dug.
 d. The greatest and middlemost Kernel.
 e. The Nipple.

For we must not think with *Galen*, *Archangelus*, *Fallopius*, and others, that these Female Genital Members, differ from those of Men only in Situation. Which Opinion was hatched by those who accounted a Woman to be only an imperfect Man; and that her Genital Members could not be thrust out by reason of the coldness of her temper; as in Men they are thrust out by virtue of their greater Heat.

Howbeit, the generative Parts in Women differ from those in Men, not only in Situation, but in their universal Fabric, in respect of Number, Surface, Magnitude, Cavity, Figure, Office, and every thing manifest to a skilful Anatomist.

that will compare what follows to what went before.

And the falsity of their Opinion is sufficiently apparent, by means of the sundry Conjectures which they bring. For some liken the Womb to the Cod of a Man, and some to the Nut of the Yard. Some will have the Neck of the Womb to answer the Mans Yard, and others will have the Clitoris. Which Conceits falling to the ground by their own weakness, I shall proceed to explain the Parts.

The *Spermatick preparatory Vessels* in Women, agree with those of Men, in

The similitude of the Yard and of the Womb, ridiculous.

The preparatory Vessels in women.

in their Number, Original, and Office, &c. I must now therefore only tell you wherein they differ.

How they differ from those in Men. They differ first in *Magnitude*. These Vessels in women are shorter, because of the short way they are to go, but therefore they have many turnings and windings which make up the *Corpus varicosum*: to the end the seed may stay long enough to receive due preparation. In the next place they differ in their Implantation. For in women they are not totally carried to the stones, but they are divided in the middle way: and the greater part goes to the stone, and makes the *Corpus varicosum*, and the lesser part ends into the womb, into whose sides it is disseminated, especially to the upper part of the bottom, for to nourish the Womb and the Child therein; and that by those Vessels some part of the menstrual blood may be purged forth in such as are not with Child. For the lesser branch being tripartite, is below the stone divided into three branches, one of which, as was said, runs out into the womb, the other is distributed to the deferent Vessel or Trumpet of the Womb, and to the round Ligament; the third branch creeping along the side of the Womb through the common Membrane, ends near the trueneck of the womb, insinuating it self also among the Hypogastrick Veins, with which and the Arteries, they are joyned by Anastomoses. Of which see *Zerbius*, *Fallopian*, *Platerus*, and others, who have shewn *Riolanus* and my self the way. That is a rare case, which is figured out by *Beslerus*, viz. for the Spermatick Arteries to be joyned by way of Anastomosis with the Emulgent Artery. For this cause in women these Vessels go not out of the *Peritonæum*, nor reach to the Sharebone: because the Stones and Womb are seated within.

These feminal Veins and Arteries are intertwined with many wonderful Anastomoses, for the preparation of seed. Yea and the Veins do receive into themselves the Hypogastrick Arteries of the Womb, according to the Observation of *Aranius* and *Riolanus*. Yet I remember the Arteries were wanting in a woman that had bore male Children, and *Franciscus Sanchez* relates how they were turned into stone in a woman of *Toulouse*.

CHAP. XXVI. Of Womens Stones.

How the Stones of Women differ from those of Men.

their

Situation; which they have within in the Cavity of the Belly, two fingers breadth above the bottom, in such as are not with Child, and are knit by means of certain Ligaments above the same: viz. to the end they might be hotter, and consequently more fruitful: since they were to work a matter of which alone Mankind was to be generated, the seed of the man being added not as a material, but an efficient Cause.

2. In *Magnitude*, which is not so great in women as in men, unless very seldom. For by reason of the increase of Heat, they are contracted after a woman is

past fourteen, whereas they are before that time distended more largely being full of a white Juicy.

3. In their external *Surface* which is more uneven, then that of a mans stones.

4. In *Figure*, which is not so round, but broad and flat on the fore and hinder parts. Also the stones are within more hollow, and more full of spermatick moisture.

5. In *Substance* which some conceive to be harder then that of mens stones, but others conceive, and that more truly, that it is softer, and if you take off the Membrane, you shall find them conglomerated or knobbed together of divers little Kernels and Bladders, but seldom like those of men. In some great sea-fish, there is no difference of the stones of the Males and Females, in substance, but only in the size.

6. In *Temperament*, which is commonly accounted more cold, and that the seed contained in them, is more moist, thin, and watery.

7. In *Coats*. For they are covered with one only Coat, because they are otherwise in a close place. And that Coat sticks exceeding strongly to them, and is by *Galen* termed *Dartos*. Howbeit, where the stones receive the feminal Vessels, they are covered half over with the *Peritonæum*.

8. In *Connexion*; for they are knit unto the womb by two manifest passages, or rather the one of them is an obscure one, out of which during carnal Copulation, there is shed, not a wheyish substance, but the womans seed.

Their *Use* is to make seed which helps to generate after its way and manner: which *Aristotle* against all Reason and Experience, was bold to deny to women, in some places of his Writings, contrary to the express Doctrine of *Hippocrates de Genitura*, where he tells us that women also send forth seed out of their Bodies, sometimes into their womb, whereby it is moistned, and sometimes without, if the Orifice thereof do gape over much. Now that in the Womb it helps to the Generation, he thereby demonstrates, in that if after Copulation. The woman shal not conceive, the seed which they have both of them voided, does flow out of the womb. But some other Anatomists deny that these stones do make seed. But they will have them to be meer Kernels, to receive that moisture which needs abound in the womb, which is the Opinion of *Cremoninus*; or that they are only made for a mark and sign, which was the Conceits of *Rhodiginus*, and of *Hofman* since him, who account them rather Carcasses of stones then true stones, because they are small, void of Juicy, and uncompact. But as for what concerns Humidity we deny that Argument, and say 1. That there was no need of so much preparation to water the womb. One Vessel gently carrying a wheyish Humor, might have served that turn, yea the Pores alone might have sufficed, as it is well known to happen in a clammy humor distilling into the Knee. 2. They may answer both Intents, viz. Generation and Irrigation, 3. Experience tells us that seed and no other humor hath issued out of the stones of women being dissected, *Guinterius* was hindred in his Dissection, by the plentiful eruption thereof. The nocturnal pollutions of women testify the same, and women became barren, when in ancient times they were gelded or spayed, Witness *Athenæus*. *Galen* experimented the same in Sows. *Varro* writes that Cows being gelded, do conceive if they go to Bull presently after. 4. The said seed is found in the Dissections of women, if they are lusty and free from Disease. In them and in Women with Child, *Beslerus* and the stones swelling with seed, which

he hath expressed by a neat Picture. 5. That it is true seed, we may gather from a real and sensible effect thereof, like that of the seed of men, as Moles, and imperfect Eggs, by reason of the difference of Sex, to which the Male adds Life and Perfection. 6. Women have sufficient heat to make seed, and sufficient instruments to that end; yea, and some of them are better provided than men. Their stones are indeed small and little, but not void of Juice. Their number does recompence their smallness, even as we sometimes see more Juice press'd out of a Bunch of Grapes, than a solid and whole Apple.

CHAP. XXVII.

Of the Vessels that carry away the Seed, especially the Trumpet of the Womb.

Concerning the Vessels which carry away the Female-seed, the Doctrine of Anatomists hath been hitherto somewhat intricate, partly through variety of opinions, and partly the obscurity of the matter it self, which nevertheless I shall endeavor to reduce, and as much as may be to illustrate the same.

The *deferent Vessels* are taken either in a large or a strict signification. Strictly for those same obscure Passages and Vessels only, which carry part of the seed bred in the stones, into the womb. Largely and generally, 1. For the preparatory Vessels also, 2. For them and the *Womb-trumpet*, which others refer to the servatory and ejaculatory Vessel. I shall speak of both briefly and distinctly.

The *deferent Vessels* are properly those small passages derived from the stones, either to the bottom of the womb, with a very short passage, or disseminated at the trumpets of the womb, with sundry, and those exceeding small Twigs, resembling the *Vena lactea*, arising from the spermatick preparatory Vessels, and continued with them, however here they change their name and use, because they immediately pass over, and lick the stones.

Galen conceives that the former is only inserted into the sides of the womb, which are termed *Cornua*, or the wombs horns, and other Anatomists are of the same opinion, who profess they could find no other Insertion. But *Zerbus*, *Fernelius*, *Laurentius*, found another Branch herefrom, which goes not into the bottom as the former, but into the Neck, so that one part of this deferent Vessel which is the shorter but larger, is inserted into the middle of the Horn of the same side, and there pourses out such seed as it hath, into the Cavity of the womb: but the other part being the narrower and longer, is carried along the sides of the womb, below the Mouth, to the beginning of the Neck. *Valisius* hath also made mention of this Part, and saies it is so small in such as have never conceived, that it cannot be found, save by a skilful Anatomist, but in Women with Child it is very large. *Spigelius*, because he could not sometimes find it, did count it a sport of Nature. *Veslingius* does seem to allow of it, seeing he brings seminal Matter from the stones, to the bottom and sheath of the womb, this way. I should willingly assent to the Opinion of *Spigelius*, because it is seldom seen. Little Branches indeed are always disseminated unto the neck of the womb, but the

from the preparatory Vessels, and bring blood rather than seed, of which see other Anatomists, especially *Platerus*, *Riolanus*, and my Father *Barbolinus* beneath.

The Use of these Vessels is, partly to carry the seminal Matter to the Trumpets, that it may be there further accomplished, and better wrought, and reserved for further use, and partly to the bottom of the womb. Where another Branch ends into the Neck, the seminal Humidity is voided this way also, causing greater delight by reason of the length of the way.

The other *deferent Vessel*, which ought to keep the Seed before it be squirted out, is the *Trumpet of the Womb*, by *Fallopian* so called, from the likeness it hath to a Trumpet of War, which he thus describes. There arises a seminal Passage, small and very strait, nervous, and white, from the Horn of the womb it self, and when it hath gone a little therefrom, it grows broader by little and little, and crisps it self like the tendrel of a Vine, till it comes towards the end. Then dismissing its wrinkled Crispations, and becoming very broad, it ends into a certain Extremity, which seems membranous and fleshy, by reason of its red Colour, and at last becomes very torn and ragged, like the jagged edges of worn clouts, and hath a large hole, which lies alwaies shut, those jagged ends alwaies falling in upon it, which nevertheless if they be diligently opened and widened, they represent the broad end of a brazen Trumpet.

I shall handle the Particulars more distinctly. The *Trumpets* arise from the bottom of the womb by one end, nor do they reach with their other end to the Stones, or any other remarkable Part. And therefore they are not manifestly passable in this other Part, but shut up and blind, so that they are like the *Intestinum caecum*, and are as it were an Appendix of the Womb. But this shutting up may be made according to the Opinion of *Fallopian*, which *Riolanus* who was since him, challenges for his own, by the fringes and jagged ends of the Trumpets, falling together, like Rags of Cloath.

They are two in Number, on each side one.

They are seated so as to compass half the Stones, but they are distant from the Stones, on every side, near half a fingers breadth, unless the womb be diseased, by which they are drawn up nearer to the Stones. They are ordinarily fastned only by very thin Membranes, not unlike the wings of Bats or Flitter-mice, through which many Veins and Arteries are disseminated, carried from the Stones into these Passages, and carrying Seed out of the Stones.

Their Substance is nervous, white, thick and hard.

Their Figure is round and hollow. Sometimes their Cavity so preternaturally widened, as to contain a Mole, which *Marquardus* relates in his *Empirica Praxis*; sometimes a Child, Examples whereof are recited by *Riolanus*. Nor could he see any other waies for the mans seed to enter, save the turning and winding Passages of those Vessels. But in a living woman, the mans seed full of spirits, might easily be drawn thither, by the widened waies of the womb misaffected, which Passages being afterwards (Conception being made, and the Trumpets distended) shut up, were not seen by Dissectors. Or whether hath there not been a shapeless Mole, or a Child without life been shaped, without the seed of a Man, of the Mothers seed only contained in the Trumpets; which having received no life from any Father, and the passages being shut up, it grew great, and kil'd the Mother?

In the Natural Figure let us consider the Beginning, Middle, and End. The Insertion or Beginning is at the

the bottom of the womb large, where it attains a nervous Pipe, stretched out to the middle well-near of the Trumper, hollow, that it may transmit the Seed to the bottom of the womb. The Middle being capacious, shews certain little Cells, containing white seed. The End is narrower, though it carry some wideness with it. Howbeit before the End, it is wreathed and crisped like the tendrel of a Vine, as is visible in Men and Beasts.

The Passage therefore of the Trumpets, is not in all parts straight, but winding, because the way is short from the stones to the womb. But the pleasure ought not to be short, when the seed is poured plentifully out of the stones into the horns of the womb in Copulation. And look what the Seed-bladders are in Men, as to preserve the seed, these blind passages may be the same in Women, when they couple oftentimes, and stil void seed. For they may be so termed, because they are annexed to the stones by little Membranes, that by Vessels brought to them from the stones, as by the milkie and mesaraick Veins, they may easily draw the seed by them concocted, and lay it up within themselves for future occasion, and send it forth when need requires.

Their Use is, 1. According to Fallopius to serve as Chimneys, by which the sooty vapors of the womb may exhale. Which I for my part cannot believe. For the sooty Vapors are condensed, and being resolved into water, are reserved till the time of Child-birth, or ascend by insensible Pores, or breath out at the mouth of the womb, both in Women with Child, because the mouth of the womb is never so close shut as to hinder, as the Examples of Superfoetation testify, as in such as are not with Child. Nor can I wel tell how the sooty vapors should find way through these crooked Passages. 2. According to the said Fallopius in his Observations, they make seed, because he alwaies found seed in them, but never saw any in the stones; to which I answered before. 3. Their true Use is, to draw seed out of the stones, by blind passages of the Vessels dispersed through the Membrane, and when it is drawn to perfect the same by some transiency in the Tendrels and Cells, by the irradiation of the vertue of the stones; that it may be more fit for a Child to be made of; finally to carry it to the womb, especially in the Act of Copulation, by those little Pipes implanted in the Horns of the womb, that it may meet the mans seed in the Cavity of the womb or its Neck, to cause Conception.

CHAP. XXVIII.

Of the Womb in General.

THE Womb is by the Latins termed *Uterus*, from *Uter* a Bottle by reason of its hollownes, in which Sense *Tacitus* does use *Uterum Navis* for the Keel of a Ship. *Isidorus* saies tis so called, because tis on each side one: in a more large signification tis termed *Venter* in the Digests and Institutes. Also tis called *Matrix*, *Utriculus*, and *Loci muliebres*, where consist the beginnings of Generation, according to *Varro*. In other Animals, according to *Pliny*, tis termed *Vulva*, especially in Sows, which the ancient Romans did account a delicate Dish: Of which see *Plutarch*, and *Langius* in his Epistles, also *Martial*, *Horace*, *Asinius*, *Arbeneus*, and among late Writers *Castellanus*. *Hofman* conceives that *Vulva* is corrupted from *Bulga*, and *Bulga* a Word

used by *Lucilius* and *Varro*, is originally French, if we believe *Festus*, who renders it a Bag. *Nonius* interprets it to be a Satchel or Knapfack hanging about a Mans Arm. See hereof *Vossius*. But the term *Vulva* is approved by *Celsus*, and the Authors formerly commended.

It is situate in the Hypogastrium, or the lower Part of the lower Belly, which is framed in the Cavity termed *Pelvis*, by the *Os sacrum* and the Flank-

Why the womb is placed in the Hypogastrium.

bones. And therefore that *Pelvis* or Basin, is larger in Women: and therefore they have Buttocks greater and wider. Now it was requisite that it should be so placed, that the Womb might be distended according to the greatness of the Child, and that the Child might be conveniently excluded.

Moreover the Womb is placed in the middle inclining to no side, save sometimes when a Woman is of Child with a Boy or a Girl: for then the Child lies more to the right or left side, though that be no certain Rule.

Now it lies between the *Intestinum rectum* or Arse-gut, which is beneath it, and the Bladder which lies upon it, as between two Pillows. Why therefore should we be proud who are bred between Dung and Urine?

Its Magnitude is considered in length | Its Magnitude. depth, and thickness, and all these vary in respect of Bodies, Age, and Venerie.

Its Length in those of a middle stature, who use Venerie, from the external Privity to the bottom end, is commonly eleven fingers; the bottom is three fingers.

The Breadth of the bottom, is two or three fingers, because in Women not with Child the latitude of the bottom and neck is one and the same. And hence the amplitude may easily be conjectured.

But in *Virgins*, which have not attained to ripeness of Age, it is little and less then the Bladder: in such as are full of Age it is greater: yet if they abstain from Venerie it is small enough, though thick, as it is also in very old Women. But it is greater in such as have oft conceived, and bore Children: that a man may well near grasp it in his hand, unless when the Women are great with Child: for then it is more and more enlarged, and whereas before Gravitation, the bottom of the Womb did not pass beyond the beginning of *Os sacrum*, it reaches afterward to the Navil and beyond, so that it rests upon the thin Guts.

The thickness of the Womb does vary after the same manner. For in Virgins the substance thereof is thin, in grown persons thick: and by how much a Woman hath been oftner with Child, by so much is the substance of her womb the thicker.

Whether the womb becomes thinner in women with Child.

When the Courfes flow, the womb grows thick; and when the voidance of the Courfes is at hand, the substance of the womb appears swelling and thick. In Women with Child, *Galen*, *Vesalius*, and other Anatomists conceive, that the womb the more it is stretched, the more it is attenuated, &c. that its thickness is spent in its length, as *Galen* speaks. But ocular Experience makes against this, and the Authorities of *Sylvius*, *Mundellus* a Surgeon of *Parr*, *Aranthus*, *Varolus*, *Platerus*, *Baubinus*, *Heurnius*, *Rousetus*, and *Laurentius*. For from the first Conception until the Birth, it is increased according to all Dimensions, and becometh as larger a little thicker and softer, so that in the last months the wombs substance is two fingers

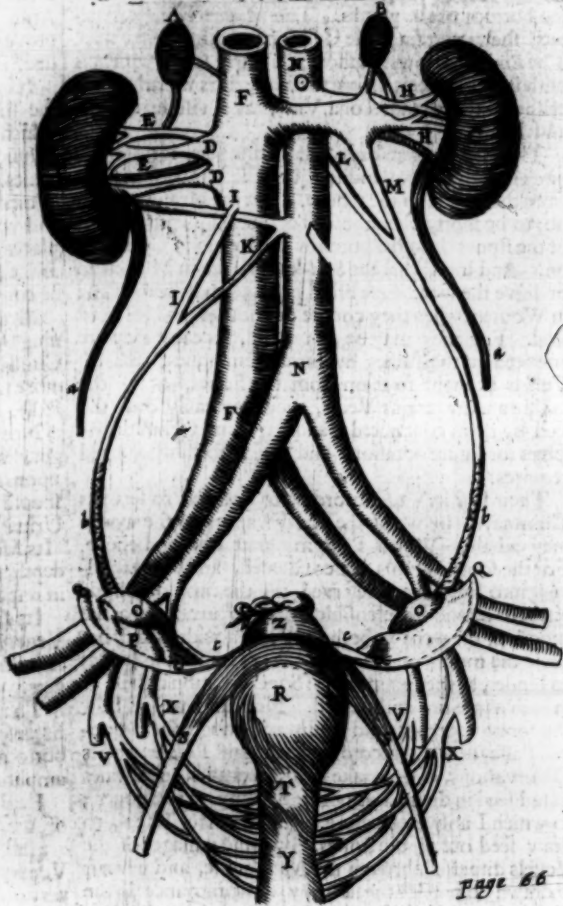
An Error of Galen and Vesalius.

The Explication of the FIGURE.

This TABLE presents the
Generative Parts of Women
taken out of the Body.

- A. The right side deputy-Kidney.
- B. The left deputy-Kidney.
- CC. The Kidney on both sides.
- DD. The right side emulgent Veins.
- EE. The right side emulgent Arteries.
- F. The Trunk of Vena cava.
- G. The left emulgent Vein.
- HH. The left emulgent Arteries.
- II. The right spermatick Vein.
- K. The right spermatick Artery.
- L. The left spermatick Artery.
- M. The left spermatick Vein.
- NN. The Trunk of the great Artery.
- OO. The Stones in Women.
- PP. A broad Ligament, like the wings of Bass
or Flitter-mice.
- QQ. The Trumpers of the Womb.
- R. The Bottom of the Womb.
- SS. The round Ligaments of the Womb, cut
off at the Share.
- T. The Neck of the Womb.
- VV. The Hypogastrick Veins on both sides.
- XX. The Hypogastrick Arteries on both sides,
carried unto the Neck.
- Y. The Sheath or Scabbard of the Womb.
- Z. A Portion of the Intestinum rectum, or
Ase-gut.
- aa. The Ureters cut off.
- bb. The Vasa pampiniformia, or Vessels crisp-
ped like the Tendrels of a Vine.
- cc. A Passage or deferent Vessel to carry from
the Stones to the Horns of the Womb.

The XXVI. TABLE



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fingers thick. The Womb does then so far depart from a membranous Substance, and becomes red, and of a fungous and spungie Substance, and full of holes like a Pumice-stone, divisible as it were into many Barks and Shells: which happens because of the plentiful Afflux of Blood and Spirits for the Child. Touching both Opinion *Falcobergius* thus judges; that the Substance of the Womb does indeed become more thin, as he observed in Dissections of Women with Child; but that it seemed thicker, because the Womb-liver does grow exceeding close thereto, and that this might deceive many. But *Nicolas Fontanus* saies, that in the womb of a Woman with Child, he hath separated the Womb-liver from the Membrane, and that he hath found the Membrane to be exceeding thick. Which may very well be, for the Membrane being spungie, drinks in the affluent moisture of the womb, and puts on a thicker condition of Substance. If at any time it happen to be præternaturally thin, either through defect of Humor, or through much Distension, it is easily broken. And *Salmuth* hath observed as much in a Childbed woman, by reason of strong Forcers. Now the Substance of the womb is thickest of all about the internal Orifice, which is strait, whence proceeds that the admission of the Dilatation in Childbirth, and Constriction of the Cervix.

The Figure of the Womb is by some counted round, by others Pear-fashion'd. But though the Womb incline to roundness that it may be of the greater capacity; yet we conceive with *Soranus* and *Fallopins*, that its bottom may best of all be resembled to a Gourd; because it is by little and little strained downwards. But the Neck of the Womb resembles an oblong and round Pipe or Channel.

The Connexion is either of the Neck of the Womb or of the Bottom.

The Neck is tied by its own substance, and by membranes; but the Bottom by peculiar Ligaments.

On the fore-side the Neck grows to the Pils-bladder and the Share-bones, by Membranes arising from the Peritonæum. In the hinder part to the Os sacrum, and the rectum Intestinum, with some Fatness. But about the Privity it grows together with the Fundament. On the sides, it is loosely knit by certain Membranes to the Peritonæum.

The Bottom is not fastned by its Substance, but is free, because it ought to be moved, as shall be said in its Action. (tw) before a Venetian woman died of pains in her

The true Figure
of the Womb.

The Ligaments
of the Womb.

her womb, the bottom thereof being tied by the Call) but in the sides it is knit by *two pare of Ligaments*, whose use is to hold the womb suspended or dangling.

The upper Ligaments of the Womb. One upper pare is broad and membranous, and is held to arise from the Muscles of the Loins; and it ends into the bottom of the womb, near the horns.

It is loose and soft, that it may be distended and contracted. *Aretius* likens it to the wings of Bats or Flitter-mice. And by help of this pare, the bottom is fastned to the Bones of the Flank. But because it is interwoven with fleshy Fibres, therefore *Vesalius* and *Archangelus* have, perhaps not unjustly, reckoned them to be Muscles. Now they carry along the præparatory and deferent Vessels, even as they contain the Stones. Now this pare of Ligaments or Muscles, is sometimes loosened by violence, difficult Labor in Childbed, weight of the Child in the

The falling down of the Womb.

Womb, &c. so that the Bottom of the Womb falls into the Privy, sometimes with the Neck inverted; also sometimes it hangs out, and is cut off; in which case also it is necessary that there be a Solution of the Connexion of the Neck.

The Lower. The other pare is lower, being round like Earth-worms, reddish like Muscles (whereupon some have conceived them to be Muscles, that perform the Office of the Cremasters in Men, so that the Womb is by them moved up and down, or at least is established and strengthened, in carrying Burthens, expelling the Child, Outcries, and Labors, in Deflux of Humors into this Part, which *Opinion Pinæus* embraces. Also it is hollow, especially in the end. It arises from the sides of the Bottom of the Womb, and at its beginning touching the deferent Vessels, it ascends to the Groins, and as the spermatick Vessels in men, so these Ligaments in Women pass along through the productions of the Peritonæum, and the Tendons of the obliquely descendent Muscles of the Belly, and there they are obliterated into Fat, or Membranes of the Bones near the Clitoris, to which they are fastned, and degenerated into a broad and nervous thinness. Where two other Muscles begin, without the Belly, being thin and broad, cloathing the whole inner face of the Lips; by help of which, some women move the Lips. The remaining part of the foresaid Ligament, runs to the Knee, and afterward into a Membrane of the inner part of the Thigh. Hence it is, as *Riolanus* acquaints us, that women with Child do in their first months complain of a pain in the inside of their Thighs.

The Use of this Part is, 1. As hath been said, to draw the Bottom of the Womb upwards, least it should fall down in relaxations, in bearing of weights, and in taking off pains; which nevertheless be more rightly said of the pare. 2. To hinder the ascent of the womb towards the upper parts, which of it self cannot happen, unless wi hal the Privities which are continued therewith, and the sheath be drawn upwards, but in the womb relaxed, and distended, it often happens. 3. *Riolanus* suspects that the excrementitious Humors of the womb are sometimes carried into the Kernels of the Groins, by these Ligaments, where also he hath found venereous Bubo's raised. Otherwise, *Hippocrates* draws the Bubo's in the Groins of Women from their Courses, which *Avicenna Severinus* refers to critical Abscesses, and *Arantius* seeks out their Passages in the Veins, by which the turgent Humor is carried from the womb to the Groins. I put the Arteries in place of Veins, whereby Excrements are both here and in other parts, carried to the extremities or out-

most places in the Body. 4. *Spigelius* in a Woman kil'd with over much carnal Copulation, observed these Ligaments near the Womb, full of Seed. Which makes me suspect that these Ligaments, having received a Seminal Moisture, do moisten the neighbouring Parts in Women with Child, that all Parts may more easily be loosened and stretched in Virgins and barren Women, they are meer Ligaments, and by their Moisture defend the womb from the violence of burning Heat.

The Substance of the womb is membranous, that it may be dilated and contracted, as need shall require, furnished with many pleits and folds, which in Women with Child are stretched out, to widen the womb, but they are contracted when the Child is excluded, and in aged women. Besides these pleits, it hath in women with child Pipes and large Cavities, or Cells exceeding manifest. Now the Substance of the womb is made up of a common and proper Membrane.

The common is doubled, and grows to the sides on each hand, arising from the Peritonæum, being exceeding thick, and most firm for strength, smooth every where, save where the Spermatick Vessels enter, or the Ligaments go out.

The proper and internal is also double; though it is hard to discern so much, by reason of its close adhesion, save in Exulcerations. And between both there were fleshy Fibres, such as are found in the Stomach; which some call the proper Substance and Parenchyma of the womb (whereinto a spongie Body is here and there strewed) and the use thereof is to heat the womb. But these Membranes are not of the same thickness alwaies: as was said before, when I spake of the Magnitude.

The Vessels of the womb are Veins, Arteries, and Nerves.

The Veins and Arteries accompanying one another, are carried between the Coats of the womb, and pour forth their Blood into those membranous Pipes of the womb, but are not carried into the inmost Cavity of the womb. And they are twofold: some arise from above, others from beneath. For, from the upper and lower parts, that is to say, from the whole Body, the Blood ought to come, both that in the monthly terms, the whol Body may be purged, and also that in the time of a womans going with child, her Fruit might be nourished. Those which come from above, do creep all the womb over, but especially in the bottom thereof, and they are Branches derived from the Seminal Vessels, before the præparatory Vessels are constituted, and also from the Hæmorrhoidal Branch, whence there is so great a Consent between the Womb and the Spleen.

The left ends of the Veins and Arteries are joyned with the right ends; that the right part may also be augmented with plenty of Blood. The Menstrual blood is shed forth by the Arteries in Women not with Child; and therefore according to the Observation of *Walens*, if about the time of the Menstrual Flux, the Pulse of the Heart and Arteries may be made greater, then the blood is more vehemently forced into the womb by the Arteries, and so the Menstrual Flux furthered. We see also when we have given Cordials appropriate to the womb, and stirring the Spirituous part of the Blood, that then the Courses encline to flow. Finally, the colour of the Menstrual blood in healthy women, declares that it is Arterial blood. Now it runs back again to the Heart, by the Veins, and to the Arteries, for all that Blood neither

Why the left Veins of the Womb are joyned to the right

neither can, nor must be voided out of the Body, when they are obstructed, because the blood cannot freely pass upward out of the lesser Veins of the womb into the greater, the Menstrual blood is collected in great quantity, and makes great commotions of the womb. Those Veins and Arteries which come from beneath and ascend, do arise from the Hypogastrick Branches of the Cava and the Aorta, and creep through the neck of the womb, and the lower part of the bottom, where they are every where joyned with the superior ones.

*Anastomoses
in the womb.*

For very broad Vessels are united through the bottom, both without, and in the substance of the womb, which Anastomoses do more appear in menstrual women, and in such as are with Child. And they may be easily observed, if in dead Bodies some of them be blown up. For they all swell by that blast into one. The Mouths of these Vessels or Pipes rather, do enter into the Cavity of the bottom, and are called *Acetabula* or *Cotylidones* Cups or Saucers: which gape and are opened, when the Menstrua are purged. And in Women with Child, when the womb-liver is joyned to them (in Beasts the *Verticilli* or Tufts) drawing blood for the Child. And because Branches are carried into the neck of the womb from these Vessels, by them women with Child that are Plethorick, may void Menstrual blood in their first months, when there is more blood then needs to nourish the Child. For it is not probable, that that blood comes out of the womb: for the Child would be suffocated, and through too great opening of the internal mouth of the womb, Abortion might follow.

*The Largeness
of the Uterine
Vessels.*

Now it is observable, that the Vessels of the womb, do in the time of a womans going with Child so swell with blood, especially about the time of Childbirth, that they are as big as the Emulgent Veins, or half as big as the *Vena cava* or *Aorta*.

Nerves very many in number, are carried from the pates of the Nerves of *Os sacrum*, and from the sixth Conjugation of the Brain, to the Neck of the Womb, and the parts about the Privities for pleasures sake: as also to the lower part of the Bottom. Whence there is a great Sympathy betwixt the Womb and the Brain. To the upper part of the Bottom few Nerves are carried, and they are intertwisted like a Net.

*The Action and
use of the womb.*

The *Action* and *Use* of the womb, is to attract and retain the womans seed expelled by her Stones, and the mans seed, cast in by his Yard. Both these Seeds are drawn into the bottom, retained, conserved, and cherished, whence proceeds Conception. For the Womb is like a Garden or Field, which receives, preserves, and nourishes the Seed: and therefore *Aristotle* calls it the Field of Nature. For even the womb is also a Field of Generation, the place or manner wherein, affording also Nutriment of Arterial blood, yea and the Matter of which viz. the womans Seed; for the Spirituous substance of the Mans Seed, is the Architect which performs the work, and gives life to the womans Seed. Now the Seed of both of them, ought to be fruitful with the formative virtue which falls from the whole Body, and well and duly constituted; the womans being fit to receive the animated form, and the mans to give the same. To the internal Heat of which two Seeds joyned together, the external Heat of the womb joynes it self, and by a singular virtue, stirs up that same inbred formative faculty, to perform its work, by a way together unknown. *Hogelandus* adds the *Formative* Action

it self impressed upon the Seed, and the due *Situation* of a certain Mass in the Seed, because we see that of an Egg never so little shaken, no Chicken is ever hatched, and alwaies in the midst of the Seed of Animals, a little after Conception, we find a certain chrystalline transparent Mass. Certain it is, that all the Particles of the Seed, have a peculiar Determination, referring to that Part of the Body of the Parents, from whence they came, and which they are to form in the Child. But the change of this, or that determinate cloter of the Seed, does only vary the *Situation* of the Child formed in the Womb, which is the cause that we find the Child variously situate in the Womb. Eggs that have been shaken, seem to be less fruitful, by reason of the confusion and rupture as it were, of the singular determinate parts, and the loss of the Heat. *Fabricius*, *Pacius*, and *Harvey* do attribute the formative or shaping Faculty to the Womb, and deny the same to be in the Seed; wherein they are mistaken. For, 1. Chickens are hatched out of the Eggs, only by the sitting of the Hen or some other Bird, also in a bed, in the artificial Furnaces of *Egypt*, *Tuscany*, *Denmark*, and Seeds of corn do sprout upon Chamber-floures, without the assistance of any womb. 2. The external Members would sooner be shaped then the internal. 3. The Father should contribute nothing to the formation of the Child. 4. No cause could be given of the likeness of the Child, sometimes to the Father, otherwhiles to the Mother. Now the Followers of *Des Cretes*, and amongst the rest *Regius* do aver, that the Particles of the Seed are agitated only by the Heat of the womb and of the Seed, and they being agitated, in regard of their figures, do necessarily fall into the Branch of a Live-wight, just as when the oblong Particles of Salt, agitated in water by the force of Heat, and joyned one with another, do first make a plate, and by the frequent multiplication thereof a four square grain or corn, and as of six little balls agitated upon some plane and united together a Rose is made; and as of the Particles of Vapors arising out of Cellars in cold weather and variously smiteing upon their doors, with a whirling motion, sundry pictures of the parts of Plants are formed. And out of the said Branch or Stalk, by little and little the whole shaping of the Child is perfected without any understanding of the Soul, or any corporeal Faculty, directing the same, as in the Work-houses of Glass-makers after a Bubble of Glass is rudely cut, Gloves, Boots, and other things are blown by ignorant persons that come to see the works; and in some Fountains, by reason of the figures of the Pores in the Pipes, we see Images formed by force of the water breaking forth. A neat way, truly, of Conception and Formation in the womb, if it were true. No man is able in this Matter to trace the Workmanship of Nature. But I cannot as yet persuade my self, that all things are done rudely and mechanically in the Body, who have alwaies had an higher Opinion of Nature then so. By this means a Man were an accidental Being, and his first shaping would be accidental and fortuitous, or by chance medley. The figures of the foresaid things happen by accident and contingently, and vary in the Particulars, whereas the Divine Shape of the most noble Creature Man, is alwaies one and the same, and happens of it self after the same manner. How could that Branch be formed without the Mind, which is not in our Hands? I profess I know not. For a Glass is formed by the widening and working of an inanimate Matter, and as in the formation thereof, there is required the blast and the hand of the Artificer, with the assistance of the fire; so in an animated Child, the internal

The FIGURES

Explained,

The Womb taken out of the Body, with the Stones, and all kind of Vessels fastned thereunto, and the Piss-bladder.

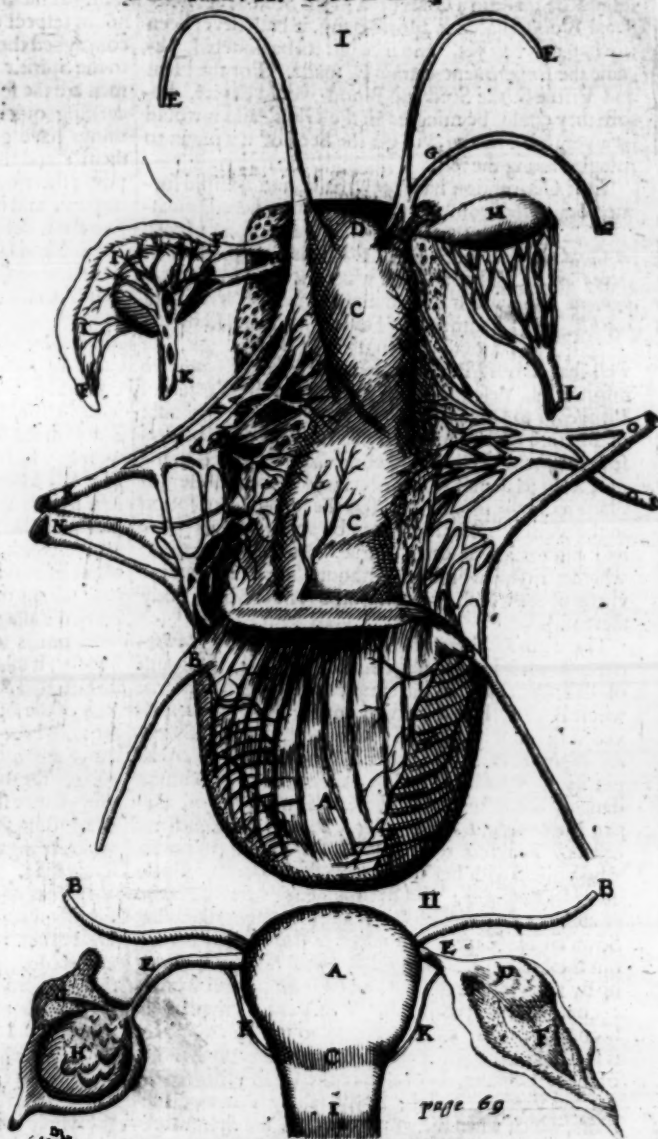
FIG. I.

- A. The Piss-bladder turned upside down.
 BB. The Insertion of the Ureters into the Bladder.
 CC. The Neck or Sheath of the Womb into which very many Vessels are disseminated.
 D. The Bottom of the Womb.
 EEEE. The two low and round Ligaments of the Womb cut off.
 FF. The Vas caecum, or trumpet of the Womb, as yet fastned to this upper and broad Ligament.
 GG. The same Vessel on the opposite side, separate from the broad Ligament.
 HH. The deferent Vessels of both sides, ending from the Stones to the Bottom of the Womb.
 II. The upper and membranous Ligament of the Womb, resembled to the wings of Batts, through which very many Vessels are disseminated, arising from the preparatory Vessels.
 K. The preparatory Vessels of one side, as yet not freed from the membranous Ligament.
 L. The preparatory Vessels of the other side, freed from the membranous Ligament, that their Insertion into the Stone may be discerned.
 MM. The Stones of which the right is covered with its Membrane and the left quite naked.
 NN. Very many Veins and Arteries spread abroad into the Neck and Bottom of the Womb, serving for the monthly Purgation and the Nourishment of the Child.
 OO. Nerves spread up and down through the Body of the Womb, which are represented by the Graver too large.

FIG. II.

- A. The bottom of the womb.
 BB. The lowermost round Ligaments of the womb cut off.
 C. The Region wherein the inner Mouth of the womb is placed.

The XXVII. TABLE



- D. The right Stone covered with its Membrane.
 EE. The deferent Vessels reaching from the Stones to the Horns of the womb.
 F. The upper and membranous Ligament of the womb, fastning the deferent Vessels to the Stones.
 G. The Membrane of the Stone separated therefrom.
 H. The glandulous or kernelly Substance of the Stone.
 I. The Neck of the womb, commonly called the Sheath.
 KK. Passages arising from the deferent Vessel, and carried into the Neck of the womb, into which they set Women with Child do squirt their Seed.

ternal formative Faculty of the Animated Seed, does join it self to the Heat of the womb and of the Seed. Nor is the Formation of the Child only apparent, as the artificial Images of water are, but true, constant

and permanent. *Abensina*, *Paracelsus*, and *Amanus Lustanus*, have contrariwise been persuaded that a Child may be generated out of the Mothers womb: but none will be forward to believe them, unless

they could shew us some example, which their Followers will never be able to do. For that a little child should be made in a Glass of a Mans Seed and Menstrual Blood, placed in Horfe-dung, it hath never been my hap to see as yet, and it ought to be doubted, because the Experiment cannot be made. For the Heat and Virtue of the Seed and Blood would expire, before they could be mingled in the Glass, and it would be a very hard matter, to get the Seed of a woman to mingle among the rest.

That Conception hath been made, and a Child formed out of the womb, some Examples testify. Touch-

A Child conceived in a womans Stomach.

ing the Trumpet of the womb, I spake before, from the Relation of *Reolanus*.

That a Child was conceived in the Stomach of a young woman the Wife of an abominable Taylor, and voided by her mouth the length of a mans finger, but

well shaped in all Parts external and internal. *Salmuth* informs us, describing the Story from the Letters of *Kemelerius* to *Gothofredus Hofmannus*, nor does he doubt of the truth of the Story. That the same may be performed in the neck of the womb, those Superfecundations, seem to demonstrate, which are voided in the first place to make more room for the larger Conception in the womb. But these are to be accounted very rare and præternatural cases, if true. But Superfecundation, whether in the womb or without, depends from the virtue of the womb, reaching all over the whole Body thereof.

The womb is therefore necessary to preserve the Species or kind. Howbeit it contributes also to the health of the Individual, as the emunctory or censer of the whole Body. Howbeit very many women have lived very long, and happily without it, witness *Abenzoar*, *Aegineta*, *Wierus*, *Zacutus*. When it hath fallen out putrified, it hath been all in a manner cut off without danger, according to the Observations of *Rhases*, *Carpus*, *Mercurialis*, *Langius*, *a Vega*, *Pavæus*, *Baehnius*, and others. *Fernelius* tells us he saw a childing woman, who voided with her Child her whole womb, pluckt away by the roots, without danger of life. *Saxoni* relates other Stories of like Nature. *Savonius* saies that Sows are made more corpulent in *Galatia*, by cutting out their wombs. *Pliny* tells us that Sows were hung up by their fore Legs, and had their stones and wombs cut out, that so loosing the use of Venerie, they might become more fat and delectable to the Palate. Nor is it without reason, because the womb is the Mother of many Diseases, by reason of the Obstruction of the narrow Vessels, and the ready falling down of Humors, which when the womb is away, are more readily purged out by a larger passage.

The wombs motion.

Moreover another action of the womb is said to be a certain Natural motion: whence *Plato* would have the womb to be a certain Animal or Live-wight, and *Aretius* saies it is an Animal in an Animal, because of its motion. For in carnal Copulation, and when it is possessed with a desire to conceive, it is moved now up and then down, and gapes to receive the Yard, as a Beast gapes for its Food. And sometimes it is moved downwards, to expel the Child and Secondine, with so much violence, that it falls out.

Moreover it is moved with, rejoices in, and is delighted with sweet smelling things: but it shuns stinking and strong smelling things, as *Castoreum*, *Asafortida*, &c. Hence *Aristotle* saies, that women with child will miscarry at the smell of a Candle-stuff.

But the womb is sensible of Cold not under the

formality of Odours, but is only affected by the delicate and subtile vaporous matter conjoynd. Even as we see al the Spirits recreated, by sweet smelling things, not in respect of the smell precisely, but of the vapor conjoynd therewith, which is familiar and acceptable to the Spirit. And therefore the Genital parts of women are the sooner affected, because they have an exceeding quick Sense. And because sweet smelling things have good and pleasing Vapors joynd with them; and stinking things have filthy and ugly Vapors; therefore by the latter, the Spirits are made more impure, and because the womb is full of Spirits, therefore she is delighted with sweet and fragrant things, and abominates such as are stinking.

And nevertheless, some women are found whose wombs are badly constituted, who are put into Fits of the Mother by sweet smelling things, and cured by such as stink: because Na-

Why sweet smelling things do hurt some women.

ture being provoked to Expulsion by the latter, does with the stinking Vapors expel the morbidick Matter. But with the former filthy Vapors are stirred up in the womb, which before lay hid, so that they ascend to the Midriff, Heart, Brain, &c. whence proceed strangling Fits of the Mother. Now these Vapors ascend partly by the sensible Pores, and partly by the Veins running back, and carrying the said Vapors with the uterine Blood: for I cannot allow of the power *Helmont* assigns to his ruling Parts, without manifest and known Passages. Now the womb it self does not ascend, nor is it moved out of its place, unless being distended, it takes up more room then ordinary, nor does it roule up and down like a Bowl or Globe in the Cavity of the Belly, as *Hippocrates* and *Fernelius* have imagined. Nor do the horns of the womb being swelled, move any more then the womb it self, as *Reolanus* suspects, for they are fastned by their Membranes, and they cannot shed their Seed into the Belly, the waies being stopped, but Vapors have an easie motion, which being dissipated, the Swelling of the Belly presently falls.

Besides its Sense of Smelling, Tasting, Feeling, it is furnished according to *Helmont*, with a kind of brutish Understanding, which makes it rage, if all things go not according to its desire. But these things favor of the Opinion of *Plato*, who improperly did compare the womb to a living Creature. Whence that fury proceeds, I have already declared. As for what that same Novellist *Helmont* saies, that it lives many times, and keeps a coile after a woman is dead, no man will easily believe it. For its life depends upon the life of the whole Body; and if it stir after death, either that motion proceeds from winds, or from a Child seeking its way out, after the Mother is dead, as sundry Examples demonstrate. *Spbix Theologico-Philosophica*, tells us that the Mother being dead, a Child suddenly issued out of her womb, and cried lustily. After which manner *Laurentius* describes the Birth of *Scipio* and *Manilius*. *Eberus* hath two Examples of a Child born after the Mothers death, as also *Johannes Matthæus*, and the like cases are fresh in the memory of many here at *Hafnia*. But in opposition to *Winchlerus*, *Sporlingensis*, and others that deny it, we must observe, 1. That the Child must necessarily be strong. 2. That the Office of the Mothers womb must be large. 3. That the Mother being dead, the mouth of the womb must be widened, and her Thighs spread, or else the Child will be strangled before it can come forth.

Chap. XXIX. Of the Bottom of the Womb, and its Mouth.

See Tab. XXVII. **W**EE have treated hitherto of the Womb in General, and its similar Parts. The *dissimilar Parts* follow, into which we have divided the same: viz. the *Bottom*, the *Neck*, and the *Privy*, with the Parts annexed.

The *Fundus* or Bottom of the womb, is that part which reaches from the internal Orifice to the End upwards. We divide it into the lower and narrower part and the larger upper part; to which we ad a third part viz. the Mouth.

The short Neck of the womb. The lower and narrow part, is that between the Mouth of the womb, and the beginning, largeness thereof, and it may be called the short Neck, to difference it from the true and long Neck. For before the wideness of the womb begins, between it and the inner Mouth, there interceeds another Neck as it were, or narrower Channel, then the largeness of the Bottom, and this is observed both in Man and Beast. And *Fallopins* is of Opinion, that this part was called the Neck of the womb by the Ancients, as *Galen*, *Soranus*, &c. *Pineus* reckons this part to be as long as a mans thumb, I have observed it to be five fingers breadth, long in a Doe.

Some Cause of Barrenness. The Cavity hereof is not large, but such as will admit a Probe or large Quil. It is rough, least the Seed which hath been drawn in, should flow out again, as happens in some barren women, which have this part slippery, by reason of bad Humors. This roughness arises from wrinkles, which according to the Observation of *Pineus*, have their Roots situate beneath, and their Edg tending inwards or upwards, that they may easily admit, hardly let go any thing.

The Bottom. The large and upper Part is chiefly termed *Fundus* or the Bottom, and this Part is properly called the Womb or *Matrix*, and it is the principal Part for whose sake the rest were made, being wider and larger then the rest.

It is seated above the *Os pubis* or Share-bone, that it may be there dilated and widened.

No Cavities or Cells in the womb of a woman. The womb hath in a woman only one Cavity, not distinguished into any Cells, as some falsely attribute therunto seven Cells. In Brutes it is commonly divided into two parts, and therefore those parts are called the two Horns of the womb: though the form of Horns is not conspicuous in all Brutes, but in Cows, Does, Sheep, Goats, &c. Howbeit in imitation thereof, Authors have attributed horns

Why Horns are said to be in the wombs of women. to the wombs of women, because on the sides of the bottom thereof, there is on each side some protuberancy, where the deferent Vessels are inserted. But the womb of a woman is very seldom divided into two parts, as it is in Beasts, as it hath been observed in some by the *Brater* of *Bambinus*, *Sylvius*, *Riolanus*, and *Obsequens* before them. And I doubt whether their wombs be so divided, who bear two or more Children at a Birth. The last year many women at *Hafnia* bore Twins contrary to their custom, yea and some three Children at a Birth, which they never did before nor

since. We must not therefore account that to be proper to Families, or attribute the same to the wombs being double, which properly belongs to the Seed. Also that they are not conceived in a double womb, the womb-cake testifies, which alone is sufficient for many Children, only it hath so many strings fastned to it in several places, as there are Children, as *Beslerus* hath lately described it in a like History.

Yet is it divided into the right and left part. In the former Boys are for the most part ingendred: in the latter Girls. And it seldom happens otherwise, if we believe *Hippocrates* and *Galen*. Hunters have this sign whereby they know whether the Beast they hunt have a male or female in her belly, for if when she is struck dead, she fall on her right side, they conclude she is big of a Male, because the burthen she goes with is most weighty on the right side; if on the left she fall, they judge it is a Female. 'Tis reported that women with child of a Boy, do lift their right foot higher then their left, as they walk, as *Salmuth* gives us to understand, all which signs are nevertheless fallacious. *Hippocrates* and his followers do reckon other signs, which are not proper for this place.

The right and left side are differenced by a Line or Seam which sticks up obscurely, which *Aristotle* termes the Median Line. The like Line is seen in the lower Belly under the Navil, dividing that Region into two parts, which they conceive to be then more visible, when women bear twins. But in some women with child I have seen this Line manifest, who bore afterwards only one Child.

The outward Surface is smooth and even, and covered as it were with a watry Humor. The inner part hath many Porosities, which are Mouths, through which in the time of a womans going with child, blood easily passes out of the Veins of the womb to nourish the Infant.

Its Use is to receive the Seed, contain the Child, nourish it, &c.

The Orifice or inner Mouth of the womb The inner Orifice of the womb. is oblong, and transverse, but very narrow (but when it gapes, it is round and orbicular, which is perhaps the cause why the German Midwives call it the Rose, and the French Midwives, the Crown of the Mother) like the Hole of the Nut of the Yard, that no hurtful thing may enter in, nor the Seed drawn thither, easily pass out. If at any time it fall out of the Privy, or be turned inside out, it resembles exactly the Mouth of a Trench.

If the Situation thereof be changed, so that it be not just in the middle, looking towards the bottom, tis conceived a Man cannot squirt his Seed thereinto, and that the Seed will sooner flow back, then the woman conceive. If it be quite absent, which seldom falls out, an incurable Barrenness is thereby caused. As also Barrenness is caused, if it be otherwise affected,

Some Causes of Barrenness. viz. with Cancers, scirrhus Tumors, Obstructions, Callosity, over much Farness: especially through over much Humectation and Relaxation, either through over much Copulation as in Whores, or through too great a Flux of Humors.

In women with child a glewwith clammy Matter grows to the Orifice, and fills the short Neck well-near; that these Parts being moistned, may more easily be opened in the time of Travel.

Within the Channel of this Mouth to the lower part thereof, grows its little bunch, which does more exactly shew the sole, according to the Observation of *Riolanus*.

lanus. He also informs us that about this little bunch, there are to be seen Pores or little Holes, which seem to be the ends of the deferent Vessels, ending at the Neck. Columbus found those Vessels implanted like the teeth of a comb, full of Blood.

The Use of the Orifice of the womb By this Orifice, the womb draws the Seed into it, which being conceived, it is said to be shut so close, that the point of a needle cannot enter. And therefore Physicians do vainly squirt Liquors thereinto with a Syringe, and Whores endeavor in vain to draw out the Conception. But it is opened in Superfecundation, in the Ejection of a bad Conception without hurt to the Child, which sometimes happens in the Emission of Seed, but it is especially opened after a wonderful manner at the time of Child-birth, when it ought to be widened according to the greatness of the Child, so that the wideness is in a manner equal from the bottom of the womb to the Privy, whereout the Child passes. And this saies Galen we may wonder at, but we cannot understand. And he admonishes us upon this occasion, that it is our duty to acknowledge the Wisdom and Power of him that made us. But this Orifice as well as the womb, does chiefly consist of wrinkled Membranes, which being smoothed out, will admit of unimaginable Dilatation.

When the Mouth of the womb is opened.

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Chap. XXX. Of the greater Neck of the Womb.

See Tab. XXVII. IN the Bottom of the Womb we have observed three things; the Bottom it self, the lesser Neck, and the Orifice. In the greater Neck also, three things are to be noted. The Neck it self, the Hymen, and the Mouth of the Bladder. Of the Hymen we shall treat in the following Chapter.

The Neck or Channel of the womb, is by Aristotle also sometimes called *Matrix*, and the Door of the Womb, *Fallopian* calls it *Sinus pudoris*, the Privy. It is a long Channel, being hollow even when the Child is in the womb, admitting both a Probe and a mans finger, as may be seen in such as are new born.

It is situate between the external and the internal Mouth, receiving the Yard like a sheath.

Its Figure. The Neck is somewhat writen and crooked, also it is shorter and straiter, when it is loose, and falls together; that the internal parts may not be refrigerated. But it is straight and widened. 1. In carnal Copulation. 2. In the monthly Flux. 3. In the time of Child-birth, when it is exceedingly stretched according to the Shape of the Child; whence also proceeds the exceeding great pains of women in travel; and then as also during their Courses, women are very much cooled.

Its Magnitude. The length thereof is eight fingers breadth commonly, or seven; so as to be as long as a Mans longest finger. It is as wide as the *Intestinum rectorum* or Arse-gut. But the longitude and latitude of this part are so various, that it is hard to describe them. For in carnal Copulation, it accommodates it self to the length of the Yard, and this Neck becomes longer or shorter, broader, or narrower, and swells sundry waies according to the lust of the woman. And when that happens, the Caruncles swell with Spirits which fill them, as appears in Cows and Bitches desire

Copulation; but the Channel is made narrower and less, as also in the Act of Generation, that it may more close embrace the Yard: and therefore its

Substance is of an hard and nervous flesh, and somewhat spungy, like the Yard; that it may be widened

and contracted within, the upper part is wrinkled, when it is not distended, but being widened, it is more slippery and smooth. Howbeit in the Neck of the womb also when it is distended, there are

Wrinkles in the Neck of the womb.

many orbicular wrinkles in the beginning of the channel near the Privy, most of all in the fore part next the Bladder, less towards the *Intestinum rectum* on which it rests; and they serve for the greater Titillation caused by the rubbing of the Nut of the Yard against the said wrinkles. And in young Maids these wrinkles are straiter, and the Neck narrower, through which the Menstrual blood is voided; also in grown persons that are yet Virgins. But the wrinkles are worn out, and the sides become callous, by reason of frequent rubbing. 1. In old women. 2. In such as have used much Copulation, or have frequently bore Children. 3. In those that have been troubled with a long Flux of the Courses, or of the Whites. And in all these the substance does also become harder, so that it becomes at last gristley, as it were old women, and such as have born many Children. But in young Maids, it is more soft and delicate.

The Use of the Neck is to receive the Yard being raised, and to draw out the Seed.

Finally, beyond the middle towards the end of the Neck, in the fore and upper part, not far from the Privy, comes

The Orifice of the Bladder.

the Insertion of the Bladder into sight, that the Urin may there be voided by the common Passage. It is as long as a knuckle of ones finger, without fleshy, or rather covered with a fleshy Sphincter. Pinæus observes that it is black within, of the same substance with the Piss-pipe in Men, as any man may see, now *Riolanus* that told us so.

Wierus hath noted in his Observations, that the outer extremity of the Neck of the Bladder, does not in all women appear in the same place, in many tis seen above the outer straits of the neck of the womb, under the Nymph; in some few it lies hid inwardly, in the upper part of the Privy. But the entrance into the Bladder, is found on the back-side, when the Membrane called *Hymen* is there: of which we are now to speak.

Chap. XXXI. Of the Membrane called Hymen.

THE Hymen or Membrane called *Eugon*, is by others called the closure of Virginitie, and the Flower of Virginitie, because where it is, there is a sign of Virginitie.

See Fig. IV. and V. of Tab. XXVIII.

Now whether or no there is any sign of Virginitie, ought not to be doubted. For all Men find that marry Virgins, that there is somewhat that hinders their Yard from going in, unless it be thrust forward with great force and strength. Whence *Terence* saies the first Copulation of a Virgin is exceeding painful. And at that time for the most part, blood issue with great pain, more or less; which Blood is also called

That there is some true sign of Virginitie.

For

Why Virgins are pained in their first carnal Copulation.

For by reason of the widening of the strait Neck of the Womb, and the tearing of the Hymen, all Virgins have pain and a Flux of blood in their first Copulation. Younger Virgins have more pain and less Flux of blood, because of the driness of the Hymen and the smallness of their Vessels; but those that are older, and have had their Courses, have less pain and greater flux of blood, for the contrary causes.

An Exception.

But if her Courses flow, or have flowed a little before: the Yard is easily admitted, by reason of the Relaxation of those Parts, whence there is little or no pain, and little or no flux of blood. And therefore Maids ought not to be married at that season, least the Bridegroom come to suspect the Virginity of his Bride.

What is the token of Virginity.

Now what it is that hinders the Yard from entering, that is to say, in what part the token of Virginity consists, there are sundry Opinions and Differences.

The I. Opinion of the Arabians.

I. The Arabians say the Hymen is a piece formed of five Veins at the middle of the Neck of the womb, inserted on either side, so that the Mouths of the right-side Veins are joyned with those on the left.

These are Fancies.

The II. Opinion.

II. Others (among whom are *Fernelius* and *Ulmus*) do say that the sides of the Neck grow together, and when they are separated and widened, the Veins are broken which run in those Parts. But this is contrary to Experience, which witnesseth, that in little Girls the Neck hath its Cavity, nor do the sides thereof stick together.

The III. Opinion.

III. Others say it is a transverse Membrane. And herein they are right. But they are deceived, who have feigned it to have Holes in it like a Sieve, and placed it in the lowest end of the Neck: through which they would have the Urin to be voided.

The IV. Opinion.

IV. The newest Opinion of all, is that of *Severinus Pmaus*, a most expert Surgeon of *Paris*, who hath wrote an whole Book of the Notes of Virginity, not unprofitable to be read. Now he accounts the four Myrtle-shap'd Caruncles to be the Hymen, tied together by a small Membrane, placed in the outer part of the neck of the womb; of which hereafter. And some learned men are at this day of his Opinion, as *Baubinus* for one. I could find no other in a young Girl, lately dissected in this place.

The V. Opinion of Stengelbened by many Authors.

V. The more common Opinion is, that the Hymen is a transverse Membrane going athwart the neck of the womb, a little above the Neck of the Bladder, which resists the first Entrance of the Yard. And many Experiments and Authorities stand up for this Opinion. And in the first place of four most renowned Anatomists, of *Padua*, *Vesalius*, *Fallopianus*, *Aquapendent*, and *Casseri*. And all Antiquity had some knowledge hereof. Hence the Author of that old Friers verse, or riming verse.

Est magnum crimen perumpere virginis hymen.

Tis a huge sin to break the skin of a Virgins Gim.

Archangelus, *Alexander Benedictus*, and *Wierus* assent hereunto. *Carpius* also knew as much

as *ger* seem to have been ignorant hereof in the 1. Sect. of his 175. Exercitation, where he speaks of a Root that extremely excites Lust. For he saies; *If any shall piss thereon, they say he will presently be full of fleshy desires: Virgins that look to Cattle in the fields, if they sit thereon or make water, tis said the skin in their Privy will break, as if they had been deflowered by a Man.* *Columbus* and *Sebizius* did three times find it, *Baubinus* twice, as he avers in his Book of the similar Parts, and *Wolffius* seems in his Institutions to assent thereunto, who witnesseth that he found it at *Padua*. *Adrianus Spigelius* affirms that he found it in all the Virgins that ever he did cut up, and I my self and *Veslingus* at the same time saw it at *Padua*. Nor is it necessary to bring all the Authorities which might be had in this subject to this place.

And whereas *Columbus* and *Parvus* deny that it is alwaies found, and *Laurentius* saies he could never find it: the reason was that they wanted Bodies to dissect, or were negligent in their work; or they might dissect supposed Virgins who had been deflowered. Or if they dissected young Virgins, they through wantonness do sometimes with their fingers break the said Skin or Membrane. But if they shall say they did cut up abortive Births, Girls of two or three years old &c. I answer tis incredible that the Hymen should be wanting in such, seeing the Authorities and Experiences of skilful Anatomists forecited, are against it. Again, if in some by them dissected, it was wanting; by the same right that they say this Membrane is præternaturally present, we shall say it was præternaturally absent. For it is seldom absent, and for the most part present. And others that are for *Laurentius* against us, such as *Capivaccius* and *Augenius*, are to be rejected as persons not skilled in Astronomie.

VI. There is a midling Opinion of *Melchior Sebizius*, viz. that all

the signs of Virginity must be joyned together, when they are present. And when the Hymen or Skin so called is absent, we must rest in the straitness of the Neck and other marks, which being widened in the first Copulation, pain and effusion of blood follows by reason of the Solution of Continuity.

These things thus premised, let us come to the Structure of this Hymen or thin Skin which goes cross the neck of the womb.

Tis situate in the neck of the womb, near the end thereof, just behind the Insertion of the Neck of the Bladder, or a little more inward. For the Situation does now and then vary, though the difference is but little. And there this Membrane goes cross the Cavity, like the Diaphragma or Midriff.

Its Figure. In the middle it hath an hole like a ring, so that in grown Maids, it will admit the top of ones little finger, through which hole the Courses flow.

But *Aquapendent* hath many times found this hole in a threefold difference.

I. As being Naturally constituted, and just opposite to the external Privy.

II. Higher, and not just against the Privy.

III. That in the middle was no round hole, but a chink somewhat long. *Sebezius* likens it to the horned Moon a little full. For Nature sports her self in the variety of Shape.

But seldom is the Hymen without any holes: then the Courses cannot come away, whence

last Dissection. Death, unless it be open

The Configuration of such as deny it to be alwaies found in Virgins.

The VI. Opinion.

The hole in the middle of the Hymen, is of several fashions.

Its Magnitude. On its sides, where it grows to the neck of the womb, tis thicker then in the middle.

Its Connexion. It is continued to the Substance of the Neck, as if it grew out of the same.

Its Substance is partly membranous, partly fleshy, nor yet very thick. And in some it is thinner and weaker then in others. As in the Prayan Virgins of *Campania*, who are there all devirginated after twelve years of age, partly by the Heat of the Sun, partly of their own Bodies breaking the Membrane, as I was told by Relation of Friends there. In some it is more solid and thick, and sometimes so strong, that it must be cut open, especially when the Bridegroom is lazie and impotent: for if he be a lusty Carle, he is wont after some months labor, to make his way through.

This Membrane is furnished with many little *Veins*, which being broken in the first Copulation, pain and blood-shed arises. Finally, it wears away at last, either through Copulation, or wanton rubbing; even as in men the *Frænum* or bridle of the Yard is sometimes torn.

A Question touching the shedding of blood in the first Copulation.

But there is a great and serious Question, whether or no in the first carnal Act, all Virgins must needs void Blood, as a certain sign of their Virginity?

I answer, that it happens so for the most part, and ought alwaies so to happen. And therefore in 22. of *Deuteronomie*, at Marriages the bloody cloath was shewed to the Elders, as a witness of the Virginity of the Bride. *Leo Africanus* saies the same custom was used in *Mauritania*, and I was told by a Syrian, that it is observed at this very day in *Syria*. *Augenius* indeed out of *Rabbi Salomon* and *Lyranius*, do understand this Text Metaphorically, as if the spreading of the Garment did signifie, the words of witnesses, by which the Chastity of the Bride was diligently enquired into and declared. But the best Interpreters retain the Literal Sense of the Words. *Sebizius* proves that it was to them a perpetual sign, because 1. Their Virgins were married very young. 2. Every one was careful of himself because of the Law of *Jehevab*. Others contrarywise conceive that it was a sign for the most part. *Marius* excepts when the Bridegroom is impotent, and a Surgeon may easily judg in such a case. *Sennartus* saies in that Law the affirmative Inference is good, but not the negative; and that nothing else can be concluded, but that where it is, it is a sign of Virginity. Therefore it may be hindred, and not appear.

1. If Virgins break it through wantonness with their fingers, or some other Instrument. Hence it is that some Nations, sow up the Privities of Girls new born, leaving a little way for the Urin to come forth; nor do they open it till the time of Marriage: and then the Bridegroom causes it to be opened, that he may be sure he hath a Virgin.

2. If it be the time of her Courses, or she have had them a little before.

3. If the Chink in the Hymen be very long, for then there happens only a Dilatation and no breaking.

4. If the Neck of the Womb be very wide, and the Yard not sufficiently thick.

5. If the Man thrust in his Yard cleverly.

6. If the Virgin have had the falling down of the womb, whereby the Hymen was broke.

7. If the Virgin be in years before she is married.

8. If by continual Deflux of sharp Humors, the n be either moistned or fretted, which frequents in sickly men, through fault of their Con-
e badness of the Climate healthy

Hebrew Virgins, being in a good Climate, and of a strong Constitution, did easily by care avoid these Inconveniences.

The Use of the Hymen is, to defend the internal Parts from external Injury. 2. To testify a Maids Virginity.

Now a Maid may conceive without hurting the token of her Virginity, which *Americus Vespurius* relates to have been common in the Indies, and *Speronius* and *Peramatus* prove the same. *Tis reported that at Paris* a certain woman in this present Age wherein we live, was got with Child, without any Detriment to her Virginal Parts, and a like History is related by *Clementina*. Which we may conceive to be done five manner of waies, reckoned up by *Plempius* and *Sinibaldus*, which for Honors sake, I shall here omit. Nor does this any waies prejudice the Conception of our Savior, which was performed without any of these waies, without the Embracement of any Man, and only by the overshadowing of the Holy Spirit, of which it belongs to Divines to treat. If we believe *Suidas*, the Membrane was by the Midwives found in the Virgin *Mary*, when it was question'd, whether she had lost her Virginity or no; which I conceive to have been inconsistent with the Modesty of that blessed Virgin. The living *Simon Magus*, that he might be reputed for a God, boasted that he was born of his Mother *Rachel*, she being a Virgin. *St. Augustine* conceits that in the State of Innocence, the Seed of the Man might be conveyed into the Womb of the Woman, her Virginity remaining uncorrupted, even as now Menstrual blood comes out of the womb of a Virgin, without any Detriment to her Virginity. Which Opinion *Vives* does explain and approve.

But that Women can become fruitful without the Seed of a Man, is incredible. For *Caranza* judges that Story of *Pomponius Mela*, of certain hairy women in an Island, which are fruitful without any Copulation of Men, to be a Fable. Touching *Incuba*, the Question is different, which I have handled in another place. It was lately reported in France, that *Magdalena d' Auvermont* the Wife of *Hieronymus Augustus de Montelione* a French Knight, did conceive a Son called *Emmanuel*, only by imagination, which *de Lord* a Professer at *Montpelier*, made to be suspected, and *P. Sanchez* in the same place did wish me not to believe it. Old Authors relate that Mares in Portugal, do conceive by the wind, *Ludovicus Carrizus* does justifie their report. But *Justinus* the Epitomizer, does more rightly explain their meaning to have been only to note the fruitfulness of those Mares, and the speediness of their Conception.

CHAP. XXXII.

Of the Womans external Privity in General.

Where the Neck of the Womb ends, there begins the last and outmost part of the womb, viz. The Womans Privity, or the outward Orifice, or Mouth of the Neck of the womb; others call it *Vulva quasi valva*, as if you would say a folding Door, also *Cunus* a cunio from a wedge, or from an Impression (whence in a Manuscript of English Receipts, I have found it called the *Print*) *Plautus* calls it *Salvus*, a Wood or Grove, or

straight. Also by another Metaphor he calls it *Coneha* the Shell-fish, and *Nave* the Ship; others commonly call it *Natura muliebris*, the Womens Nature. *Varro* tells us the Romans called it *Porca* the Furrow or Parsley-bed, the Sow. And what Experience of biting made, *Suidas* and *Eustatius* call it *cuneiron* or *cuna*, the Dog, let those judge that can speak by Experience.

It is only one in Number. *Obsequens* tells of a Woman that had two Privities, and *Lycerus* hath observed many such as Monsters.

Its Situation is external, in the former Region of the Share-bones, where very many parts are to be seen without Dissection, and some without drawing open the Lips; as the Hairs of the Share, the Lips, and the Hillocks themselves; the great external Chink, the Wings, the Tentigo; but some parts cannot be seen without drawing the Lips aside, as the *fossa navicularis*, the two smaller Chinks by the Nymphs, the bodies of the Clitoris, the Hole of the Neck of the Bladder, with a fleshy Valve, the wrinkled Chink or immediate Mouth of the Neck, with four Caruncles, and as many Membranes: where afterwards the Channel begins of which we have spoken.

The Hairs of the Share in such as are ripe, break out about the Lips, the better to close the Chink. And they are in Women more curled than in Maids; of sundry colors, being produced by Nature, partly the shelter, and partly to cover these parts, which she judges ought in decency to be covered. But the Italian and Eastern Women out of a desire of cleanliness and neatness, do by Art remove these Hairs as unprofitable.

The Lips being drawn open, there appears I. *MAGNA FOSSA* the large Trench or Ditch, with the outer GREAT CHINK, and we may call the foresaid Ditch *Fossa navicularis* the Boat trench, because of its likeness to a little Boat or Ship. For it is backwards more deep and broad, that the lower and after-end might degenerate as it were the Ditch or Trench. In this Ditch the Lips being opened, two Holes appear, but hardly visible, save in live bodies, out of which a good quantity of wheyish Humor issues, which moistens the Mans Share in the time of Copulation. The Orifice or Beginning of the Neck of the Womb, is in the middle of this Ditch.

Now this Ditch with the external Chink were to be large, that the Child might in the external part come out more easily, seeing the Skin cannot be so stretched, as the membranous Substance within may be.

Then we meet with two COLLATERAL CHINKS, which are less: the right and the left, and they are between the Lips and the Wings.

Now in this large Ditch, there are first of all to be seen certain Caruncles or little Parcels of flesh, of which we are now to discourse.

CHAP. XXXIII.

Of the Myrtle-shaped Caruncles.

See Fig. IV. of Tab. XXVIII. IN the Middle of the Ditch or Trench aforesaid, appear four CARUNCLES or little Particles of flesh, presently after the Wings.

They are so situate that each possesses a corner, and oppose one another in manner of a quadrangle.

One of them is before in the circumference of the hole of the urinary Passage, to shut the same (it being greater then the rest, and forked.) least after the water is voided, any external thing as Air, &c. should enter into the Bladder.

The second opposite to the former, is situate behind, the two remaining ones are Collateral.

Their Shape resembles the Berries of Myrtle.

Their Size varies, for some have their shorter, longer, thicker, and thinner then others. Howbeit they abide til extream old Age, and wear not away so much as in those that have used frequent Copulation and frequent Child-bearing.

They have some Membranes joyned to them, which *Pincus* together with the Caruncles terms Valves: so that their substance is partly fleshy and partly membranous.

The Hole in the middle between these Caruncles, is of various size, according to the age of the Party. Howbeit *Riolanus* hath observed, that in Virgins it equals a third part of the great Chink.

Also He conceives, these Caruncles are made by the wrinkling of the fleshy sheath of the Privity, that the external part being narrower then the sheath, may in time of travel be widened as much as it. And therefore in a Child-bed Woman, after she was brought to bed, he observed them for seven daies quite obliterated, by reason of the great distention of the Privity, nor is there any appearance of them till the Privity be again straitened and reduced to its Natural form.

Their Use is, I. to defend the internal parts, while they immediately shut the Orifice of the Neck, that no Air, Dust, &c. may enter. To which end also the Nymphs and Lips of the Privity do serve.

II. Fortitillation and pleasure, while they are swollen, and strongly strain, and milk the Yard as it were, especially in young Lasses.

But *Pincus* will have their use to be far different. For he saies these Caruncles, whose Extremities are fleshy Membranes, are so bound together, as to leave only a little hole, and so to make the Hymen or true Mark of Virginity. Nor will he have it seated across or athwart, but long-waies, so that the figure of the whole Hymen should make an obtuse cone, or a cone with the sharp end cut off.

CHAP. XXXIV.

Of the CLITORIS.

Allopius arrogates unto himself the Invention or first Observation of this Part. And *Columbus* gloriously, as in other things he is wont, attributes it to himself. Whereas nevertheless *Avicenna*, *Albucaasis*, *Ruffus*, *Pollux* and others, have made mention hereof in their Writings.

Some call it the Nymph, as *Aetius* and *Egineta*. *Columbus* terms it *Dulcedo amoris* the Sweetness of Love, and the Sting of *Venus*; because this part is the chief Seat of Delight in carnal Copulation: which if it be gently touched in such as have long abstained from carnal Embrace-ments, and are desirous thereof, Seed easily comes away. The Greeks call it *Cleitoris*, others name it *Tentigo*, others the woman's Yard or Prick: both because it resembles a Mans Yard, in Situation, Substance, Composit^o Repletion, with Spirits and Erect

The Names of this Part.

Cleitoris.

Its likeness to a Mans Yard.

The FIGURES Explained.

This TABLE comprehends the Sheath of the Womb, the Body of the Clitoris, and the external Female Privity, both in Virgins, and such as are deflowered.

FIG. I.

- AA. The Bottom of the Womb dissected cross-waies.
- BB. The Cavity of the Bottom.
- C. The Neck of the Womb.
- D. The Mouth of the Neck in a woman that hath bore a child.
- EE. The rugged inside of the Neck cut open.
- FF. The round Ligaments of the Womb cut off.

FIG. II.

- A. The Nymph or Clitoris rather in its proper Situation.
- BB. The Hairs of the Privities.
- C. The Insertion of the Neck of the Bladder near the Privity.
- DD. The Privity.
- EE. The wings of the Privity.
- FF. The Neck of the Womb cut off.

FIG. III.

- A. The Body of the Clitoris sticking up under the Skin.
- BB. The outer Lips of the Privity separated one from another.
- CC. The Alae or wings, and the Nymphs likewise separated.
- D. The Caruncle placed about the Urin-hole (a)
- EE. Two fleshy Myrtle-bap'd Productions.
- FF. Membranous Expansions which contain the Chink.

FIG. IV. Presents the Privity of a Girl.

- a. The Clitoris.
- bb. The Lips of the Privity.
- cc. The Wings or Nymphs.
- d. The Orifice of the Urethra or Piss-pipe.
- e. ff. b. Four Myrtle-bap'd Caruncles.
- e. The upmost Caruncle which is divided into two, and shuts the Passage of the Piss-pipe.
- g. The Hole of the Hymen or Virginity-skin.
- h. The lowest Caruncle.
- i. The Fundament.

The XXVIII TABLE



FIG. V. Letter A. Shews the Membrane drawn across the Privity, which some have taken to be the Hymen or Virginal-skin.

FIG. VI. Shews the Clitoris separated from the Privity.

A. The top of the Clitoris resembling the Nut of a Mans Yard.

B. The Fore-skin thereof.

CC. The two Thighs of the Clitoris cut off from the protuberancy of the Hip or Huckle.

FIG. VII. The Clitoris cut asunder athwart, its inward spongy Substance is apparent.

Erection. And also because it hath somewhat like the Nut and Fore-skin of a Mans Yard, and in some Women it grows as big as the Yard of a man: so that some women abuse the same, and make use thereof in place of a mans Yard, exercising carnal Copulation one with another, and they are termed *Confricatrices Rubsters*. Which lascivious Practice is said to have been invented by *Phileas* and *Sappho* the Greek Poetesses, is

reported to have practised the same. And of these I conceive the Apostle *Paul* speaks in the I. of *Romans* 26. And therefore this part is called *Contemptus virorum* the Contempt of Mankind.

Now the CLITORIS is a small Production.

It is seated in the middle of the Share, in the upper and former end of the great Chink, where

See Tab. XXVIII.

Its

Its *Size* is commonly small; it lies hid for the most part under the Nymphs in its beginning, and afterward it sticks out a little. For in Lasses that begin to be amorous, the Clitoris does first discover it self. It is in several persons greater or lesser: in some it hangs out like a mans Yard, namely when young Wenches do frequently and continually handle and rub the same, as Examples testify. But that it should grow as big as a Gooses neck, as *Platerus* relates of one, is altogether praternatural and monstrous. *Tulpius* hath a like Story of one that had it as long as half a mans finger, and as thick as a Boys Prick, which made her willing to have to do with Women in a Carnal way. But the more this part encreases, the more does it hinder a man in his business. For in the time of Copulation it swells like a mans Yard, and being erected, provokes so Lust.

Its Substance. Its Substance is not bone (though it was so in a Venetian Courtezán, who had it cut off, and the hardness whereof did inflame the Yards of the Lovers) but as that of a mans Yard, it consists of two nervous Bodies hard and thick, within porous and spongy (that this part might rise and fall) arising distinctly from the Hip-bones, about the brims of the said Bones. But they are joyned together about the Share-bone, and make up the Body

Its Muscles. of the Yard. Its Muscles are, according to *Pineus* three, according to *Riolanus* and *Veslingus* four, like as in a mans Yard, and serving to the same Intent. The two uppermost round ones, rest upon longer Ligaments, and proceed from one and the same place; the two others being lower, broad, and fleshy, proceed from the Sphincter of the Fundament.

The ourmost End or Head, sticking out like the nut of a mans Yard (the rest lying hid) is called *Tentigo*, having an hole as a mans Yard, but no thoroughfare.

It seems to be covered with a Fore-skin as it were, which is made of a small Skin arising from the Conjunction of the Wings.

Its Vessels. Also it hath Vessels of all sorts brought unto it.

Veins and Arteries common to it and the Privy, a Nerve from the sixth Conjugation, all more large then the Nature of its Body might seem to require, to cause an exact Feeling and Erection.

Its Use. Its Use is to be the Seat of Delectation and Love. And it is like the *Frenulum* or Bridle on the Nut of a mans Yard. For by the rubbing thereof, the Seed is brought away.

Howbeit *Aquapendent* conceives that the Use of the Clitoris, is to sustain the Neck of the Womb in the time of Copulation.

Bellonius and *Iovius* do conceive that this is the part wherein the *Ethiopiáns* were wont to circumcise women. *Arius* and *Agineta* do shew us how to cut it off, confounding it with the Nymph. And even at this day, the Eastern Nations, in regard of its bignes extraordinary, do fear it, that it may grow no more. And they hire ancient women to perform this Piece of Surgery, which they improperly term Circumcision. And it is to those people as necessary, in regard of the deformed greatnes of the Clitoris, as it is comely; for at *Alcair* in *Egypt*, Wenches go naked after this Circumcision, and when they are married, they wear a Smock only. Of which things is also this kind of Circumcision, I have discoursed at large in my *Imperial Antiquities*.

CHAP. XXXV. Of the Wings and Lips.

Two red Productions offer themselves to our view between the Lips, which they term *prerugia* and *ALAS*, that is the Wings.

Galen calls them *Nymphae*, either because they do first admit the bridegroom, or because they have charge of the Waters and Humors issuing forth. For between them as it were two walls, the urine is cast out to a good distance with an hissing noise, without wetting the Lips of the Privy. Others call them the Cuticular Caruncles.

They are seated between the two Lips.

Their *Magnitude* is not always alike: for sometimes one Wing, otherwhiles both, seldomer in Virgins then in women, do grow so big, especially being frequently drawn by the fingers, or otherwise by an Afflux of Humors; that by reason of the impediments thereby happening, tis necessary to cut them. And *Galen* tells us that this Disease is frequent among the *Egyptians*; so that they are fain to cut them in Virgins that are to marry, and in other women also; and *Ætius* and *Ægineta* do speak to the same purpose, which others will have to be understood of the Clitoris. And they are in the right as I conceive, because the Clitoris being over long, may hinder the amorous Embrace, and may be raised like the Yard; but the Nymphs cannot be this way troublesome, which are softer, and in some do hang down very long, yea in Whores that trade with these Parts.

They are in Number two; the right and the left, now they are in the beginning commonly joyned together, where they make a fleshy Production, like a Fore-skin cloathing the Clitoris.

Their Figure is triangular, but one angle is blunter then the rest, viz. that which comes without the Lips. It is like a Cocks-comb: and for that cause haply by *Juvenal* termed *Crista*.

Its Color is red like a Cocks-comb under his throat. Tis covered with a thin Car rather then Skin, as the Lips and other parts of the Mouth.

Its Substance is partly membranous, soft, and spongy (bred peradventure of the doubling in of the Skin, at the sides of the great Chink) and partly fleshy.

Their Use is the same with that of the Myrtle-shap'd Caruncles. And moreover that the Urine might be conveyed between them, as between two walls. Some conceive they serve as a Ligament, to suspend and straiten as it were, in Virgins, the lower part of the external Chink, which seems unlikely. The Lips perform that Office, and the Nymphs should rather straiten such as are deflowered, in whom they are longer.

The two Lips, between which the external Chink consists, have certain risings adorned with hair, which are termed *Monticuli Veneris*, the Hillocks of *Venus*. In women they are flatter then in maidens. This Part is that which is properly termed the Privy. These Hillocks are longish, soft Bodies, of such a Substance, the like whereof is not to be found in the whole Body again; for it consists partly of Skin, and partly of spongy Flesh, under which is placed a parcel of hard Fat.

Their Junctionure of the Lips, is in Virgins right, As in Whores it is crooked and strait.

See FIG. III.
and IV. of the
Tab. XXVIII.

The Lips and
Venus Hillocks.

strait, as it were a ligamentish Substance for firmness; but in such as have lost their Maiden-head, it is loose, and in such as have had a Child, yet looser; as *Riolanus* hath found by Experience, and any body else may find that covers the Glory of such Experiments.

The Use hath been hinted before.

CHAP. XXXVI.

Of the Membranes which infold the Child in the Womb.

ALL the Parts serving for Generation, both in Men and Women are explained. But because my design is to discourse of what ever comes under knife of an Anatomist, I must also propound some things which are contained in the Womb of a woman with child, such as are

I. The Infant, whose Structure differs only in some things, from that of a grown person. Which I shall briefly recount, as I did publicly, not long since demonstrate the same, at the Dissection of a Child. Now the parts of a large Child differ from those of a tender Embryo, and the parts of both these from those of a grown Man. 1. In *Ag-nitude*, either proportionate to the whole Body, or less proportionate. 2. In *Colour*, some parts are more red, some more pale than in a grown person. 3. In *Shape*, as may be seen in the Kidneys and Head. 4. In *Cavity*, as in the Vessels of the Navil and Heart. 5. In *Number*, either abounding, as in the Bones of the Head, Breast, and Sutures of the Skull; or *deficiency* as in the Call, some Bones, of the Back, Wrist, &c. 6. In *Hardness*, as in the said Bones. 7. In *Situation*, as the Teeth. 8. In *Use*, as the Navil-vessels, and those of the Heart, the Gut Cæcum, &c. 9. In *Motion*, as the Lungs, &c. 10. In *Excrements*. 11. In *Strength* and Perfection of the Whole.

The FIGURES EX-plained.

This TABLE shews how the Parts of a Child in the Womb differ from those of a grown Person.

FIG. I.

- AA. The Deputy-kidneys.
- BB. The true Kidneys, as yet distinguished into sundry Kernels, as expressed by the Graver, in respect of their Situation.
- C. The Arteria magna, out of which branches go to the Deputies and the Kidneys.
- D. The Vena cava out of which the Emulgentes proceed, and the little Veins of the Deputies.

FIG. II. Shews the Posture of a Child in the Womb, which does nevertheless sometimes vary.

- A. The Head of the Child hanging downwards, so as its Nape is hid between its Knees.
- BB. The Buttocks so which the Heels are applied.
- CC. The Arms.
- D. The Cord drawn along its Neck, and turned back over its Fore-head, which is continued with the Womb-cake, expressed in the next Figure.

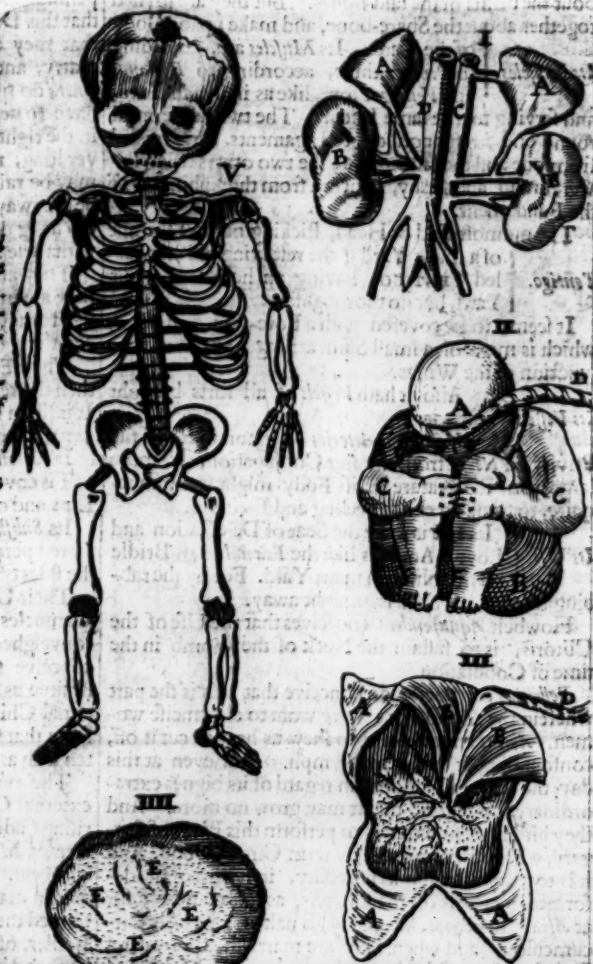
FIG. III.

- AAA. The Membrane Chorion divided.
- BB. The Membrane Amnios, as yet covering the Cord.
- CC. The hollow and inner side of the womb-cake which looks towards the Child, with the Twigs of Vessels.
- D. A Portion of the twisted Cord.

FIG. IV. Shews the outside of the Placenta, which cleaves to the Womb, though here separated, with the Clifts and Chinks [EEEE] which vary in Number and Depth.

FIG. V. Shews the Skeleton of a young Child, in very many things differing from that of a Person grown up; as appears by the Text

The XXIX. TABLE.



These things will be more evident, if we shall run over all the particles which are in a Child different from the parts of our Bodies,

1. The *Umbilical* or *Navil-Vessels*, vulgarly called the *Navil string*, are three, and hollow throughout to pass and repass the Mothers blood, which in grown persons turn to Ligaments.

2. There is little or no appearance of the *Call*, because there is as yet no publick digestion of the Stomach or Guts, and they are sufficiently cherished by the Members of the Child folded together and the heat of the Womb.

3. The *Stomach* is small, no bigger then a Wall-nut, and for the most part empty, there being no publick Concoction, or it is moistened with a clammy Humor.

4. The *Cecum intestinum* is large, sometimes thick, other whiles long, for the most part full of Excrements, of which I spake before.

5. The *thin Guts* appear contracted, colored with yellow Excrements descending through the Gall-bladder.

6. The thick Guts especially the *Rectum*, do contain thick black Excrements, from the private digestion, of the Stomach, Guts, Liver and Spleen or of the Spleen only, voided hither by the *Calicula*, or of the Liver alone, purged out by the Choler-passage. They are black, through their long stay.

7. The *two Kidneys*, are compacted of very many *Kernels*. The deputy Kidneys are large and more hollow.

8. The *Liver* with its *Duct* fills both the *Hypochondria*. The *Spleen* is small, because there is yet no fermentation in the Stomach and Veins. The color of both, is more bright and red, then in a grown person.

9. In the *Dugs* there are no kernels, only a little sign of a Nipple.

10. The *Thymus* growing to the Vessels, is visible beyond the Heart with a threefold large kernel.

11. The *Ears* of the Heart are large, especially the right Ear, and pale.

12. The *Unions* of the Vessels in the Heart, by *Anastomosis* and a little Channel, are singular, of which we shall speak in the following Book.

13. The *Lungs* shine with a yellow redness, which is afterwards allayed by their motion. Because they are at present immovable, because transpiration alone and the Ventilation of the Mothers Blood do suffice the Child in the Womb, unless it happen to cry in the Womb.

14. In the *Head* all things are large. The Eyes stick out, the skull is exceeding big, but divided into many parts, the brain is soft and commonly overflows with moisture; the *Pericranium* continued with the *Dura mater*, passes through the Sutures.

15. In the *Skeleton*, the Bones of the whole Body are soft in the first months, afterwards some are hard, according as they are of use, as the Ribs; some are gristly, as the Breast-bone, the Wrist-bone, and the Tarsus or beginning of the Foot (all without any hard *Apophysis* or *Epiphysis*) which nevertheless in tract of time do grow to a bony hardness, the middle parts growing hard first: and after their hardning some remaine one continued bone, others are divided into many Particles.

16. The *Crown* of the Head remains very long open, covered only with a Membrane, which by little and little with age grows close up. The *Sagittal* suture reaches to the Nose. The greater *Conjunctions* of the

bones are moveable, placed one upon another, that in the coming out of the Womb, the skull being pressed, may give way to the straitness of the passage. The *Os Cuneiforme* is divided into four parts. The Bones of the *Nose* and both the *Jawes* are divided, a *Gristle* coming between. The *Tooth* lie hid in their sockets, covered with the *Gums*. The *Vertebra* of the Back, have no sharp productions, that they may not hurt the Womb. The *Braist-bone* being soft, hath in the middle according to the length thereof, four little round bones, *Plane* and *Pory*. Also the *Plank*, *Hip* and *Shank-bones* are distinguished by *Gristles*. The *Carpus* and *Tarsus* are *Gristly*, and afterwards as the Child grows bigger, they are spread out into different bones, when there is a necessity of using the Hands and Feet, to handle and go.

17. In the *outward parts*, as the *Skin*, *Hairs*, *Nails*, &c. there is some difference, known to all.

II. The Membranes which invest the Child, *Scarcely* and cover it: of which in this Chapter.

III. The *Navil-vessels*, of which in the Chapter following.

The MEMBRANES which infold the Child, are the first thing bred in the Womb after Conception, to fence the nobler part of the Seed as may be seen with the Eyes, even in the smallest Conceptions, and as the Authority of all Authors well-near does testify.

Their *Efficient cause*, is the formative faculty, and not only the Heat of the Womb; as the Heat is wont to cause a crust upon Bread or Gruel. For then, the crust would stick hard to the Child and could not be separated.

II. The Heat of the Womb is not so great, as to be able to bake the substance of the Seed in so short a time; whereas these Membranes are bred well near immediately after the Conception. And if there were so great Heat in the Womb, no Conception could be made, according to *Hippocrates* in the 62. *Apborism* of his fifth Book.

We conceive their matter to be the thicker part of the womans seed, Others, as *Aranus*, will have them to be productions of the inner *Tunicles*, the *Chorion* of the *Peritonæum*, and the *Amnion* of the *Membrana coriacea*. Others that the Mothers feed alone makes these Membranes; others, that they are made as well of the mans as the Womans feed.

These Membranes in Man-kind are two, in brute Beasts three: which being joyned and growing together do make the *SECUNDINE* so called.

1. Because it is the second tabernacle of the Child, next the Womb.

2. Because it comes away by a second birth, after the Child. [Hence in English we call it the After-birth.]

The first Membrane is termed *AMNIOTIS* because of its softness and thinness, also *Agmina*, *Chorda Virginalis*, *Induratum*, &c. And it is the thinnest of them all; white, soft, transparent, furnished with a few very small Veins and Arteries, dispersed within the foldings thereof. It compasses the Child immediately and cleaves every where almost to the *Chorion*, especially at the ends, about the Womb-Cake, united in the middle thereof, where the *Umbilical Vessels* come forth. Yet we can easily separate it from the *Chorion*. There is in it

plenty of Moisture and Humors wherein the child swims which proceeds in Brutes from Sweat, in Man-

kind from Sweat and Urin. But *Agua pendens* having observed that in Brutes the Sweat and Urin were contained in several little Membranes, the latter more low and externally in the Chorion; the former higher, and more inwardly in the Amnion; he thought it was so in Mankind much more. But Experience and Reason are against it because there are no Passages to the Chorion. And because we do not find the Urachus open in Mankind, therefore the Urin cannot be thence collected in the Amnios, but is voided by the Yard if it be troublesome, and the remainder is kept till the time of the Birth, in the Bladder, which in Children new born is for the most part distended and full, but in Brutes empty. Nor does the sharpness of the Urin offend the Child in the Womb, because 1. It is but little in a Child in the Womb; because of the benignity and poverty of its Nourishment. 2. The Skin is daubed with a clammy Humor, and Brutes are defended by their hairiness. Therefore the Use is

I. That the Child floating therein as in a Bath, may be higher and less burthenom to the Mother.

II. That the Child may not strike against any neighboring hard Parts.

III. That in the Birth, the Membrane being broke, this Humor running out, may make the way through the Neck of the Womb, smooth, easie, and slippery.

Part of the Amnios does ever and anon hang about the Head of the Child when it comes forth, and then the Child is said to be *Galeatus* or Helmeted. This Helmet the Midwives diligently observe for divers respects, and they prognosticate good fortune to the Child, and others that use it, if it be red; but if it be black, the praesage bad fortune.

Parvus, Lemnius and others, conceive that the happy and strong Labor of the Mother, is the cause that the foresaid Helmet comes out with the child, but in a troublesome Labor it is left behind. *Spigelius* contrariwise, thinks that when the Mother and child are weak, it comes away. *Beslerius* makes the Reason to be the toughness of the Amnios, which the child is not able to break through, or the weakness of the child, for which cause it seldom lives to ripeness of Age. I have seen both those that have come into the world with this Helmet, and those without it, miserable; and by chance it comes to cleave both to the Heads of strong and weak children.

The second Membrane is termed Chorion, because it compasses the child like a Circle.

This immediately compasses the former, and lies beneath it in a round shape like a Pancake, whose inner or hollow part it covers and envelops, spreading itself out according to the measure thereof. It is hardly separated therefrom, and it strongly unites the Vessels to the Womb-liver, and bears them up. Towards the child it is more smooth and slippery, but where it is spread under the Womb-cake, and fastned thereto, it is

more rough: also it is sufficiently thick and double. In Brutes the *Cotyledons* cleave hereunto, which consist of a fleshy and spongy substance. But in Man-

kind, this Membrane cleaves immediately to the womb, by a certain round and reddish lump of flesh, fastned to one part only of the womb (commonly the upper and former part) nor does it compass the whole child; being framed of an innumerable company of Branches, of Veins, and Arteries, among which blood out of the

Vessels seems to be shed and interlarded.

That same round Mass is called *PLACENTA UTERI* the Womb-pancake, by reason of its Shape; also the *WOMB LIVER*: which I will now exactly describe according as it hath been my hap to see it.

Its Figure is circular, but the Circumference unequal, in which I have observed five Prominences ranked in due order, and the Membrane Chorion in the intermediate spaces, thicker then ordinary. Where it looks towards the Womb, it is rough and waved, like baked bread that hath chinks in it; and being cut in this part, it discovers an infinite number of fibres, which if you follow, they will bring you to the Trunks of the Veins.

It is one in Number, even in those who bear two or more children at a burthen. For into one Womb-cake, so many Cords are inserted in divers places, as there are children.

Its Magnitude varies according to the condition of the Bodies and the children. Yet it is about a foot in the Diameter.

The Substance thereof seems to be a Body wove together of infinite little fibres, blood as it were congealed being interposed, which is easily separated. Seeing therefore it hath a Parenchyma, it is no wonder, if like a kind of Liver it make, or prepare blood to nourish the child.

The Nature and Appearance of the Substance, is not every where alike. For here and there it is glandulous, especially in the tops of the Hillocks, as being the Excretories of the child's Work-house, placed in the outmost Verges. It is thicker in the middle of the hillocks; and thin about the brims, variously interwoven with the Capillary Veins. For,

It hath Vessels, viz. Veins and Arteries running through the same, from the Umbelical Vessels, which by little and little are all extenuated about the brims of the Womb-cake, making wonderful contextures, closely sticking to the Substance thereof, so that no part of the Branches is void. They are joynted together by various Anatomoses, which shall be hereafter described, through which the blood in the child runs back, out of the Arteries into the Veins. For I have observed in the Veins of the Womb-cake, how that the blood contained, may easily by ones finger or an instrument, be forced towards the Trunk or Cord, but not towards the Womb-cake. The contrary where to happens in the Arteries, which by impulse of the finger, do easily send the blood to the Womb-liver, but hardly to the Trunk.

Its Use is 1. To support the Navil-vessels, under which it is spread as a Pillow.

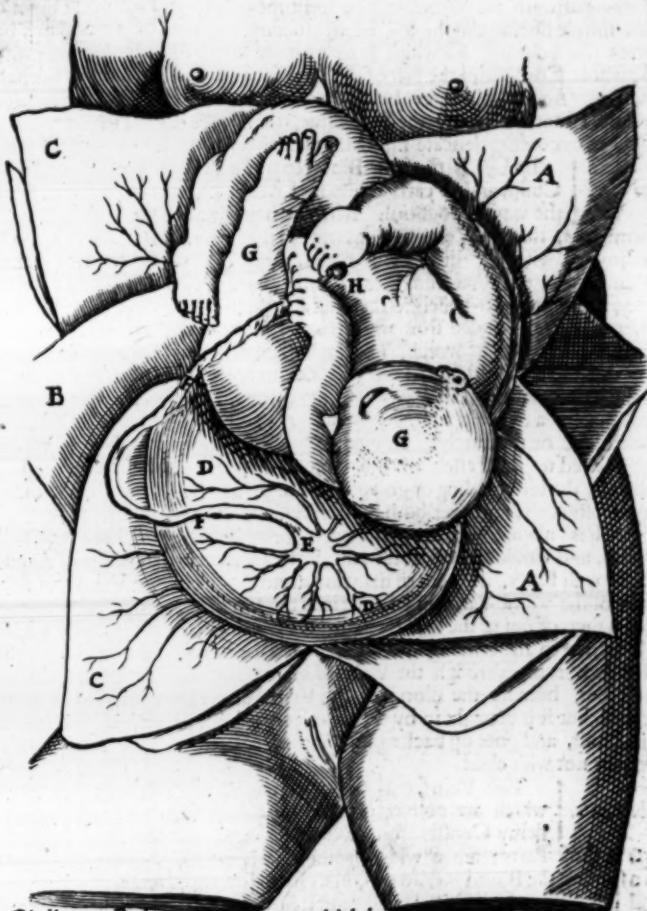
2. Because it hath a singular kind of Parenchyma, to prepare blood to nourish the Child, as the true Liver does in grown persons. For it mediately sucks the Mothers blood through its Veins, out of the Veins of the womb, and prepares and tempers it for use; and soon after sends it through the greater Navil-vein, into the Liver of the child, that it may be carried right forth unto the Heart, by the Anatomosis and little Channel; out of which by the Arteries it is distributed into the whole body of the child to nourish the same. But part of the blood returns through the Iliack Arteries, to the Womb-cake, as an appurtenance to the child, partly to preserve the same by its heat, and to nourish it with Arterial blood, partly that it may be there further perfected; which Labor being finished, it returns back again into the concomitant Veins, that together with other blood, newly supplied by the Pipes of the womb, it may pass back again by the Umbelical Veins, and repeat the foresaid Circle.

The

The FIGURE Explained.

This TABLE presents a Child in the Womb naked, al the Coats both proper and common being divided.

- AA. Portions of the Chorion dissected and removed from their place.
- B. A portion of the Amnios.
- CC. The Membrane of the Womb dissected.
- DD. The Womb-cake or womb-liver, being a Lump of Flesh furnished with divers Vessels, through which the Child receives its nourishment.
- E. The Branching of the Vessels, which in this place make one Ligament to cover the Umbilical Vessels.
- FF. The Band or Ligament, through which the Umbilical Vessels are carried from the Womb-cake to the Navil.
- GG. The Situation of a perfect Child in the Womb, ready to be born.
- H. The Implantation of the Umbilical or Navil-vessels into the Navil.



The third called ALLANTOIDES the Pudding-membrane, does not cloath the whole conception, but compasses it round like a Girdle, or a Pudding.

Its Use is, to receive Urin from the Urachus in Brutes. For in Mankind there is no such Membrane: for the child in a woman, its Urin is received by the Amnios mingled with Sweat: or is kept in the Bladder till the Birth-time. And therefore *Spigelius* cannot be excused, for admitting this Membrane in Mankind; whose Description (because it belongs not to this Anatomy) he that desires to see, let him look in *Aqua-pendens*.

Chap. XXXVII. Of the Umbilical or Navil-vessels.

THE Membranes being dissected and removed, the UMBILICAL Vessels come in view, so called, because in the Region of the Navil, the child being excluded, and the blood a little forced up to nourish the same, they are cut off, and being tied in a knot, do make

The NAVIL which is in the middle of the Belly, yea and of the whole Body, if you measure it with a circle, the Arms being stretched out.

Now there are four Navil-vessels: ONE VEIN, TWO ARTERIES, and the URACHUS. Which are covered and veiled as it were with a certain common

Coat or Crust, which some call *Intestinulus*, *Funiculus*, *Laqueus*, &c. which does not only wrap up all the Vessels, but also distinguishes them one from another.

And the Use of this Coat, is to keep the Vessels from being intangled one within another, broken, or any other way hurt.

The VENA UMBILICALIS, much greater than the Artery, being carried through the two Coats of the Peritonæum, is bred in the first place before all other Veins; in respect of Perfection, because it ought to afford nourishment to the rest.

It is seen inserted into the Liver by a Cleft, and goes through the Navil, sometimes simple, otherwhiles double, and divided into two Branches, the length of about an Ell and half, as far as

What the Navil is, and of what parts it consists.

The Vena umbilicalis.

Its Insertion.

to the Womb-cake. And it is variously coiled or round about, that its length might prove no hinderance. From the Navil it goes over the Breast, and from thence it is obliquely carried over the right and left side of the Throat and Neck, turning it self back at the hinder-part of the Head, and so over the middle of the Fore-head unto the Womb-cake; sometimes also by this simple flexure on the left hand, it compasses the Neck like a chain. All which is to be understood of the whole Cord, and the rest of the Vessels contained therein. And this Journey being finished, it spreads infinite Branches through the Secondine, till it loose it self into exceeding delicate fine hairy thrills.

Its Use. Its Use is to draw Blood to nourish the Child, and to carry it into its Liver. Now the way is doubtful. Most men perswade themselves, that the Veins and Arteries of the Womb, are joyned with the little Veins and Arteries of the Womb-cake, and that from them jointly blood is derived into the Navil-vessels to the Child. But the Arteries are to be excluded from this Office, because they are not joyned to the womb, nor ought they to carry any thing to the child, but to carry back from the child to the womb-cake. The Veins do only bring thither, and that by a twofold way, either immediately from the womb, or mediately. Immediately, when they are joyned to the Vessels of the womb; mediately, when by the interceeding or going between of any fleshy Substance whatsoever, both in Mankind and Beasts (which is alwaies for the most part glewed to the womb, and violently broke off in the Birth) it is sucked through Pipes, first out of the womb into the outer parts of the womb-cake, and thence into the Capillary Veins thereof, out of the least into the greater, till at last it is carried to the Umbilical Trunk, and to the Liver. Nor does it slip through the Veins of the womb into the Pipes, because the Blood of the Veins does not nourish, but it is brought in by the Arteries in a woman with child, and goes up back again by the Veins, in a woman not with child.

The Knots. This Vein seems full of certain Knots: which are nothing but a more thick and fleshy Constitution of the *Membrana carnosa* in those Parts; and a wider opening, wherewith as a spoon, the Blood is drawn in, in its long Journey, and is by little and little stopped, least it flow too violently; that the Blood may be there the longer labored, as we see in the Spermatick Vessels: and that the Vessels may be stronger.

By the Number of these Knots, the Midwives do guess the number of Children that a woman shal bear: and if the Knot which first follows, be white and narrow, they foretel that the next child will be a Girl, if red, round, and swelling, that it will be a Boy. The first Divination is vain; for there are as many Knots in the Navil of the last child, as of the first. But the latter may be excused by the defect or abundance of Natural heat, whence the Diversity of Sexes arises. From the distance of the Knots one from another, they foretel that the Conceptions will be sooner or longer one after another, and that there will be Twins, if one Knot rest upon, or be near to another. Which we have often found to be false, though chance, do now and then confirm the hope of credulous women.

Arteries. Two Arteries are inserted into the Illiack Arteries, and are carried with the Vein after the foresaid manner to the womb-cake, where it is spread about in divers Branches, whose Use is not, as hath hitherto been believed, to bring to the child vital Spirit with Arterial blood, because these Ar-

teries are not joyned to the Arteries of the Womb, according to the most certain Observation of *Aramius*; but to carry back part of the Arterial blood, which is superfluous to the Nourishment of the Child, by the two Illiack Branches into the Placenta or Womb-cake, partly to nourish the same, and fill it with vital Spirit. Partly that the Blood may there be made more perfect, being weakned by a long Journey, and nourishing the Membranes; which afterwards runs back again to the Child, by the hairy twigs of the veins joyned thereto, with that new blood coming out of the womb.

This Motion is confirmed by Experience. I have often pressed the swelling veins with my finger, and have observed that the blood is easily forced out of the vein towards the Child, not to the Womb-cake, where the knots like valves do stop the same; contrariwise, it is easily forced out of the Arteries into the Womb-cake. The same is manifest by Ligatures. For the Umbilical Arteries of a live Child being bound, as yet cleaving to the Mother being alive, *Waleus* hath observed and others after him, that they pulse between the Ligature and the Child, but have no Pulse between the Ligature and the Mothers womb.

For this Motions sake the vena and Arterial branches are joyned together by *Anastomoses*, within the Womb-cake, that the Passage might be ready for the blood to run back out of the little Arteries, into the little Veins.

I have here, following my own sight, observed several waies of *Anastomoses*. For sometimes the twigs of the Veins and Arteries, do go one over another crosswise, both internally and externally. Sometimes they are joyned by Infertion, sometimes they couple side to side, and sometimes they are wreathed. The smallest Twigs of the Branches are inoculated into the greater, united in like manner, but with more blunt *Anastomoses*, till the Arteries are reduced to four Branches, the Vein to two, which at last grow into the trunks of their own kind, springing out of the Womb-cake. The Arteries go about the veins, and do partly accompany them, and partly creep alone by themselves. I suspect that there are *Anastomoses* only in those places, wherein they are necessary for the passing Blood out of the Arteries into the veins, and that the solitary veins do suck fresh Blood out of the Womb.

Without the Navil and Womb-cake, these vessels being united, as they pass along like a Rope, they are well twisted one with another, yet for the most part by an orderly Circumvolution, even as a larger Rope is made of smaller cords twisted together, representing the wreathings of our Unicorns Horn, which we could easily perceive by holding it to the light. Which is so contrived 1. Least by the winding passage of the Navil-vessels, the motion of the Blood should be hindred, seeing every vessel that is twisted, keeps it course. 2. That the Child in the womb might receive its pittance of Nourishment by little and little, without danger of choaking. 3. That by this wreathed and crooked Journey, the future Aliment of the Child, might be by little and little purged and clarified.

Moreover, it is to be noted in the twisting of the cord 1. That knots and spots are transparent in the vein and not in the Arteries, by reason of the Blood appearing through a thinner Coat. 2. That a spans distance from the Conjunction there appears, a wonderful contexture, and a rougher and more confused twisting then in other Parts. 3. In the outer Coat of the Intestinum, infinite cuts and lines are seen imprinted as it were

were, according to the length thereof, colored on the outside with blood, such as are to be seen in the *Cerebellum*.

The length of the Rope. Its Length was before noted, viz. an ell and an half, in a grown child, or three spans, that the child may stir more easily, the blood may be better prepared, and the secondine drawn out. If this cord be sometime either overtwisted, or by motion wrapped about the Neck of the child, there is danger that the child will be strangled, and the Mother have an hard labor, because the child is drawn back by reason of the shortness of

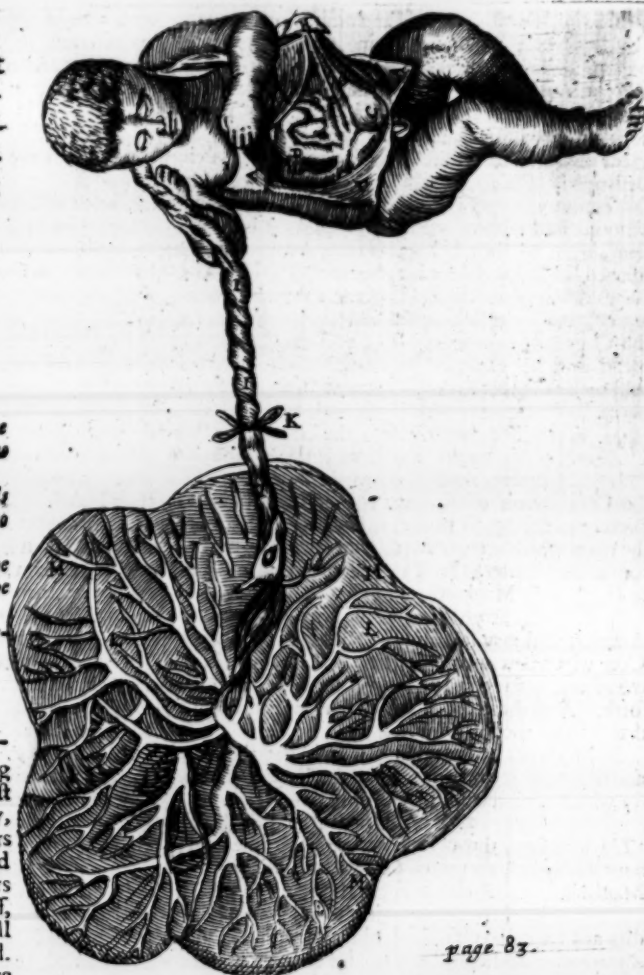
the cord, nor can it bear the violence of an indiscreet Midwife. I have seen it twisted divers times about the Neck of a child, whereby the birth was retarded for divers hours, and when the child came forth it could hardly breath: if in such a case the child's Face be red tis a good sign, but a deadly token if the Face be black and blew.

'Tis as *thick* as a mans Finger, because strength and a just capacity is requisite to sustain the Vessels. When it is dry it becomes smaller, and it is kept to procure other births.

The Explication of the FIGURE.

It shews the Child taken out of the Womb, but fastened still to the Womb-Cake, the Umbilical Vessels being separated about their Rise.

- AAA. The Abdomen or Belly opened.
- B. The Liver of the Child.
- C. The Piss-bladder.
- DD. The Guts.
- E. The Umbilical Vein.
- FF. The Umbilical Arteries.
- G. The Urachus or Piss-pipe.
- H. The Umbilical Vessels out of the Body joyned together by one Membrane.
- III. The Umbilical or Navil-vessels extended from the Chorion to the Child.
- K. A Ligature which makes the Veins beneath it full and the Arteries lank and empty.
- LLLL. The Veins and Arteries dispersed through the Womb-cake.
- MMM. The Womb-cake.



The binding of the Navil. The Child being born, the rope must be tied near the Belly, the distance of two or three Fingers breadths, with a strong thred wound often about, and about three Fingers from the binding, it must be cut off, and the Navil must be lookt to, till it dry and fall off, of its own accord. Now the times of its falling of are uncertain, in respect of the Constitution of the child, and the plenty of Blood which flows thereto, from whence the Midwives Prognosticate how long the child shall live. If it fall of the fifth day from the hour it was tied, they foretell the children will be long-lived; if on the third day, they say they shall be short-lived.

The Navil being thus shaped and confirmed, is covered with a strong Skin, which may be preternaturally stretched to an immense degree, to receive the Guts in a Rupture of the Navil, such as *Severinus* hath described in a Picture, and as my self have seen at *Hafnia* in an ancient Woman.

In some there is a passage through the Navil into the Belly. *Alpinus* reports that the Egyptians cure a bloody Flux, by thrusting their Fingers into the Patients Navil, and turning it divers times about. Dung came out of the Navil of a Student, and Worms like Earth-worms with quittor came out of the Navil of a Boy, according to the Observation of *Salmuth*. *Tulpius* saw quittor which Nature sent from the Chest, come out at the Navil, and *Folius* found Stones bred here. *I. D. Horstius* observed blood flow from the Navil in a certain Gentleman, monthly. And he tells

teis us of a Boy who had a wheyish liquor like Urin dropping from his Navil, and sometimes fresh blood. For the inner Vessels are many times opened, by the Acrimony of the blood and wheyish humors. Also the Navil doth insensibly open it self when purgatives, Medicines for the Mother and to kill the Worms, &c. are applied thereto.

Now these Vessels, after the Child is born, do within the Belly degenerate into Ligaments: the Vein to a Ligament of the Liver, the Arteries into lateral Ligaments of the Bladder. Because their use is now lost, and there is no longer any passage of the Mothers blood, unless they be sometimes preternaturally opened as in the examples alleadged. Yet

*The Dignity
of the Navil
is not much.*

are they not of so great moment, that their breaking or cutting off, should cause death, as some and among them *Laurentius* imagine, being questionles abused by some Fabulous story. For they report that the Egyptians punish Robbers by slaying them alive, and that they leave the Navil untouched, that they may be tormented the longer: for they think when the Navil is cut off a man must needs die, the four Vessels being destroyed. But *Riolanus* a man of great experience saw contrary examples, and any man may judge by a Rupture of the Navil. If death follow, it is by accident, the inner parts being also hurt, and a wide dore opened for all hurtful things to enter. *Sperlinger* conceives that they are choaked, because the Navil being cut off, the Liver falls down and draws the Midriff, the Organ of breathing. But 1. This shortness of breath doth not cause sudden death. 2. The Liver is held up by another strong Ligament from the *Peritonæum*.

Urachus. The fourth Vessel, the *Urachus* or Piss-pipe, which is half as little again as the Artery, consists of two parts, according to the Observation of *Riolanus*; the inner, which is Nervous, arising from the inner coat of the Bladder the outer which is more Membranous, from the bottom of the bladder. It is not after the same manner in Beasts as in Mankind.

In Beasts tis carried without the Navil between two Arteries, and is at last spread out and widened into the Coat which is termed *Allantoides*, where Urin is collected and reserved, till the young one is brought forth. And therefore this Vessel is termed *Urachus*, that is to say the Piss-pipe.

In Mankind, 1. It doth not go without the Navil, and therefore it doth not make the Coat *Allantoides*, for which cause the Child hath only two Coats.

*The Urachus
is not hollow in
Mankind.* 2. The *Urachus* is not hollow throughout according to the experiments of *Carpus*, *Arantius*, *Cortesi*, *Riolanus* and others, whom I have found to be in the right, in such Bodies as I have dissected both old and young, though *Aquapendens* and *Spigelius* would persuade us otherwise. But it is a little Cord or Ligament, where-

with the bladder is fastned to the *Peritonæum* and sustained, least when it is distended with Urin, its Neck should be squeezed: Though I deny not but that the same thing is done by the Arteries.

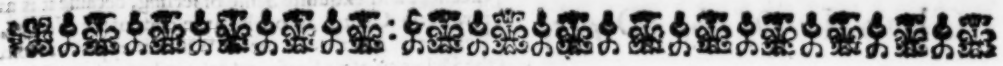
But a Child in the Womb voids Urin by its Yard into the Membrane *Ammios* (which makes it so full of Liquor) and a great part is retained also in the bladder, which is the cause that new born Children, for the first daies are in a manner continually pissing. *Aquapendens* denies this because, 1. The motive faculty doth not exercise it self in a Child in the Womb. 2. No Muscle Acts. 3. Neither doth Nature use so different a manner of voiding Urin in Men and Beasts. But I answer, 1. That the various moving of a Child in the Womb, which Big-bellied Women feel, doth witness that the Child hath a moving faculty though imperfect. 2. The bladder is provoked to excretion, by the over great quantity and sharpness of the Serum, or wheyish humor. 3. The Coat called *Allantoides* which is not in Man-kind, doth shew the difference between Man and beast.

Urolus will have all the Urin to be contained in the bladder, till the birth time. But then it would be broken with over stretching; and whence comes all the liquor which is in the Coat *Ammios*.

Aquapendens, *Spigelius* and almost all others will have it go out by the *Urachus*, and be collected between the *Ammios* and *Allantoides*, as in beasts. But seeing it is not perforated, but solid in Man-kind, it cannot admit the Urin. For it cannot be strained through, without a manifest passage, because it is thick, and the same way might hold in grown Persons. *Veslingius* propounds both these opinions and determines nothing. Now it is no more Porous in a young child then a grown person. And *Laurentius* eagerly defends this opinion out of *Galen*, bringing the examples of some, who when their Urin was stoppt, did void it at their Navil.

But I answer: This is done præter-naturally, as it is also a known opinion of many, that the Umbilical Vein hath been preternaturally opened in Hydropical persons, and voided the Water. And *Laurentius* himself confesses, that all the four Umbilical Vessels do turn to Ligaments; wherein he is right, for they are dried. How therefore can they be opened unless preternaturally? So it was I conceive preternaturally opened in the same Italian called *Anna*, who hath no Yard, in stead whereof a spongy bit of flesh hung out under his Navil, whence the Urin dropt. *Fernelius* and others have other examples of the *Urachus* opened.

Before the Production of all the Umbilical Vessels in the Womb, the seed being curdled in the top of the hinder part, two certain Roots are inserted, on each side one from the horns of the Womb, first observed by *Varolius* and called *Radices Dorsales*, the back Roots which are obliterated, when the rudiments of the Child are framed, touching which *Riolanus* explains *Aven-*



THE SECOND BOOK; OF THE Middle Venter or Cavity.

The middle Venter what it is.

THe middle Venter or Belly termed *Thorax* the Chest, and by some absolutely *Venter*, is all that which is circumscribed above, by *Clavicles* or Channel-bones; beneath the *Midriff*; on the fore-side by the *Breast-bone*; on the hinder part by the *Bones of the Back*, and on the sides by the *Ribs*.

The fore-part is called *Sternum* and *Pectus*, &c. the Hinder-part, the *Back*; the *Lateral* Parts are termed the *Sides*.

Hypocrates and Aristotle.

Howbeit the Ancients as *Hypocrates* and *Aristotle*, &c. did comprehend all from the *Channel-bones* as far as to the *Privities*, that is to say, the middle and lower Belly under the Name of *Chest*.

And therefore in this Sense *Hypocrates* did well write, that the *Liver* is seated in the *Chest*: which other unskilful persons not understanding, did imagine that *Hypocrates* was ill versed in *Anatomy*.

Its Figure.

Its *Figure* is after a sort *Oval*, though not exactly, and *Hypocrates* compares it to a *Tortoise* or the *Belly of a Lute*. In Mankind, it is more bunching in the fore-part, but in the middle of the *Breast-bone* it is flatter, about the sides round, because of the bowing of the *Ribs*, in the *Back* more flat.

Magnitude.

Its *Magnitude* in General, varies according to the different degree of *Heat*: for by the wideness of the *Chest* we measure the *Heat of the Heart*. But in particular persons it is larger towards the lower Belly, where the *vital bowels* are concealed, and grows narrower by little and little at the beginning of the *Neck*.

Substance.

Its outer *Substance* is partly bony, partly fleshy.

This middle Belly is not wholly fleshy as the lower is, 1. Because it was not to contain any Parts, that were very much to be stretched. 2. That over-much *Fat* might be bred there, and hinder *Respiration*.

Yet is it partly fleshy, because it contains Parts which ought to be moved, as the *Heart* and *Lungs*, and for the same Cause,

It could not be altogether bony, like the *Skull*; for that is a very rare case which *Cardan* mentions in his 11. Book of *Subtilties*, Page 458. in my Edition, of a Man that instead of *Ribs*, had one continued Bone from the *Throat* to the *Flanks*.

Yet is it in part bony, for to safeguard the noble Parts. For,

Its *Use* is, to contain the vital Parts as the lower and first Belly contains the *Natural*. Now the Parts likewise of this Belly are either containing or contained: and the former either common or proper.

The Common are the same which are in the lower Belly. Howbeit these things following are here to be observed.

The *Skin* of the middle Belly is hairy under the *Arm-pits*. These *Hairs* are called *Subalares Pili*, being useful to keep those Parts from wearing and fretting, in the Motion of the *Arms*, seeing they exceeding y and quickly sweat, because they are termed the *Emunctories of the Heart*, receiving the *Excrements* thereof (in some also that are hotter of constitution and strong-hearted the breast is hairy) as the *Groins* are called the *Emunctories of the Liver*.

Moreover, there is little *Fat* found in the *Chest*, if you except the *Dugs*, that *Respiration* may not be hurt by the weight thereof. For by reason of its bony part, so great plenty of the matter of *Fat* could not flow into it, as in the lower Belly, which is wholly fleshy, and therefore alwayes the farthest part of the body; the middle belly or Cavity is indifferently stored with *Fat*; the *Head* is least fat of all. But the fat it self being otherwise white, is wont in the chest to appear a little more yellow then ordinary, by reason of the heat of the vital Parts which lye under the same.

The proper Parts besides the *Muscles*, *Bones*, &c. are the *Dugs* of both Sexes, The proper the *Midriff*, the *Membrane of the Sides* Parts. termed *Pleura*, and the *Mediastinum* or Partition-wall.

The Parts contained are the *Bowels* and *Vessels*. The *Bowels*, are the *Heart* with its *Heart-bag* or *Pericardium*, the *Lungs* and part of the *Wesand* or *Wind-pipe*, or *aspera Arteria*. The *Vessels* are the *Branches of the Vena cava* and *Arteria magna*, underpropped with the *Thymus* or *Kernel* in the *Throat*. and sundry *Nerves*.

Its Use.

Its Parts.

Common.

The Use of the hairs under the arm-pits.

Why there is little Fat in the Chest.

Chap. I. Of the Dugs.

See Tab. XXV. Lib. I. According to our Anatomical Method, the first Parts in the Chest which we dissect, as soon as we have done with the lower Belly, are the Dugs. Now we shall treat of the Dugs of Women, casting in between while, wherein those of Men differ therefrom.

Why the Dugs in Mankind are seated in the Breast.

The Situation of the Dugs, is in the middle of the Breast, above the Pectoral Muscle, which draws to the Shoulder. 1. Because of the nearness of the Heart, from whence they receive heat. 2. For Comeliness sake. 3. For the more convenient giving of suck: because the Infant cannot presently walk after the manner of Brutes, but being embraced in his Mothers Arms, it is applied to the Dugs. No other Creatures have Dugs in their Breasts saving the Apes, who hold their young ones in their Arms likewise. *Laurentius* tells us the Elephant does the like, and *Riolanus* says as much of the Bat or Flitter-mouse. Some great Sea-fishes of the Whale-kind have Dugs on their Breasts, full of Milk, as we lately observed in a Whale that came out of *Norway*.

Number of the Dugs They are two in Number: not because of Twins; but that one being hurt, the other might supply its Office. Howbeit *Varro* reports, that Sows will have so many Pigs as they have teats. *Wallius* in a certain woman observed three Dugs, two on the left side of her Breast, and one on the right. And *Cabrolus* observed in a certain woman four Dugs, on each side two.

Magnitude. As to their Magnitude. In Girls new born, there is only a Print or Mark visible on the breast, and afterwards by little and little it swells, and in little wenches hardly any thing appears beside the teats, untill by degrees they grow to the bigness and shape of Apples; and when they are raised two fingers high, their Courses begin to flow. In old women they wither away, so that nothing appears but the Nipples, the Fat and Kernels being consumed.

In women they swell more, and in women with child the last months, they are more and more encreased.

The difference of the Dugs in men and women. In men they do not rise so high as in women, because ordinarily they were not to breed milk [yet because of the equality of the kind, it was convenient that men should have them as well as women.] And therefore in men, the Dugs are commonly without Kernels: yet in burly people, the Fat which is under them raised the breasts. In the Kingdom of *Sengea*, the Dugs of women hang as low as their Bellies; and in the Isle of *Amabo*, 'tis said they turn them over their shoulders to their backs, and there suckle their children.

Their Shape. Their Shape is roundish. They represent as it were an half Globe. And in some because of their over-great weight they hang down.

Their Parts. The Dug is divided into the Nipple and the Dug itself. For in the middle of the Dug there is to be seen a peculiar Substance, which,

How the Nipples come to have so exquisite Sense.

Is called *Papilla*, the Tear or Nipple, being spongy, like the Nut of a Maus Yard, and therefore it will fall

and rise when it is sucked or handled. For it hath an excellent and exquisite Sense of feeling, because it is as it were the Centre, into which the ends of the Nerves, Veins, and Arteries do meet. Which is apparent from the Delicacy of its Sense, and the redness of its color, a sure token of Blood brought in by the Arteries, by reason of the Concourse whereof, Chyrurgeons do judge Cancers and other Tumors about the Nipple pernicious.

Riolanus believes that the Skin is doubled, and as it were compressed: but the doubling would make it thicker. But the Skin is exceeding tender, easily rubbed off, and apt to be pained when the Child sucks very freely. Only in old women it grows thick. Nor is the Nipple any other where made of the Skin strained or folded.

If the Nipples turn upwards, a Male child is in the Mothers womb, if downwards a Girl according to the Tradition of *Hypocrates*, which hath not been as yet ratified by the confession of women with child.

As to Number, there is one Nipple on each Dug. *Hollerius* saw two Nipples upon one Dug, which both yielded Milk.

Their Colour in Virgins is red, in such as give suck it inclines to black and blew, and in them also they are more sticking out, by reason of the Infants sucking; in such as are past Child-bearing, the Nipples are of a black color.

They have a Circle round about them which is called *Areola* the little Parsley-bed, in Virgins pale and knotty, in such as are with child and give suck, brown, in old women black.

'Tis bored through the middle, with very small holes for the Milk to pass through: For

The Use of the Nipple is to be instead of a Pipe or Funnel, to put into the Mouth of the Infant, whereout it may suck the Milk: Secondly, to serve for a pleasing Titillation, whereby Mothers and Nurses are enticed the more willingly, and with a certain Sense of pleasure to give their children suck.

The Dugs do inwardly consist of a Membrane, Vessels, Kernels, or rather kernel-lish Bodies, and Fat: though the two last do chiefly make up the Dugs; the Kernels and Fat lye concealed between the Membrane and the Skin.

Now the fleshy Membrane does fasten the kernel-lish Substance which it compasses, unto the Muscles which lye thereunder.

The Kernels are many: In Virgins more hard, in old women consumed, in such as are with child and give suck, more swelling and pappie. Yet there is one great one, just under the Nipple, which the other lesser ones do compass about, and infinite textures of Vessels lye between them. *Riolanus* hath observed a womans Dug to consist of one continued Kernel, and not of many, the contrary whereto we see in scirrhous and cancerous Tumors.

The Use thereof is, to turn Blood into Milk. And the use of the fat of the Dug is to encrease heat, and to make the Dug of an even round shape. And therefore such as have the Fat consumed by some Disease or old Age, they hang ill favorably like empty Bladders, and are unfit to make Milk.

The Vessels. The Dugs receive their Skin and external Veins from the Axillary, which are called the *Thoracice Superiores*, the upper Chest-veins, which in women with child and such as give suck, are often black and blew visible. They receive other internal Veins, brought thither a long way, that the Blood might be the longer therein wrought, which are termed *Mammaries*.

The Vene Mammaria. *maria Vene* or Dug-veins, which descend on each side one, from the Trunk of the Axillary Vein, under the Breast-bone, to the Glandules or Kernels of the Dugs. These are met by other ascendent Veins, by the right Muscles, of

Why Milk is bred after the child is born.

which before: and therefore the Infant being born, the Blood is carried no longer to the womb, but to the Dugs, and is turned into Milk. And hence it is that women which give suck, have seldom their Courses. Hence also, when the

Children suck over-much, Blood comes out at the nipples. Yea, it hath been observed that a womans courses have come away through her Dugs, and Milk by her womb: howbeit, this is a rare chance.

But the Matter of Milk, be it what it will, cannot according to the Principles of the Bloods Circulation, be carried by the Veins to the Dugs. The *Vene mammaria* or Dug-veins, do only carry back what remains superfluous, after the Child is nourished, and Milk made. Moreover, they are seldom joyned with the Epigastrick Veins, and they are too few and small, alone to carry so much blood from the womb, as may suffice a Child that is a liberal Sucker.

Their Arteries.

Their Arteries proceed from the upper Trunk of the great Artery: and from the Subclavian branches, which are joyned after the same manner with the Epigastrick Arteries, as was said of the Veins. The *Truncice Arterie* or Chest arteries, so plentifully and evidently, that in cancerous Tumors of the Dugs, a woman hath bled to death by them, of which case I remember some Examples. Hence it seems more likely, blood is carried to the Dugs to make Milk, which blood being consumed in fat and elderly women they are therefore none of the best Nurses. Hence it is that women which give suck, receive great damage by loosing their blood; contrariwise they are advantaged, by whatever may draw and provoke their blood to their Dugs, as by rubbing them, &c.

The matter of Milk is not Blood as Martianus holds.

Now *Prosper Martianus* and *Petrus Castellus* do maintain out of *Hypocrates*, that the matter of Milk is twofold, viz. Blood and Chyle: and that the greatest part of the matter thereof, is pressed out of Meats and Drinks, not yet digested in the Stomach, into the Dugs, by the Child swelling in the womb, and after the Child is born, by the passages made wide by sucking: and that another small part is made of blood ascending from the womb, which is rather to be reckoned as an Efficient cause, by reason of its Heat, than of a Material cause.

That Blood alone is not the matter of Milk, besides the Authority of *Hypocrates*, they prove, because

1. Otherwise it were impossible that a woman should live, voiding two pounds of blood every day, in the form of Milk.

2. When a woman gives suck, her Courses flow, which in the first months of her going with child, are suppressed.

3. When a woman left breeding Milk, she would fall into a dangerous Plethora, or fulness of Blood.

4. There would be no Child-bed Purgations at all: the Milk being so violently carried into the Dugs, the second day after Child-birth, that it causes a Fever.

5. Nature would then have framed greater Vessels from the womb unto the Dugs.

6. The Milk would not retain the smell, and virtue or operation of the Meats eaten, because these things are changed in the blood.

7. The Blood collected into the Dugs, does breed Madness. *Aphor. 40. Sect. 5.*

But that it depends upon the Stomach and the Chyle, these following Reasons evince.

But arises from the Stomach & the Chyle.

1. The force and efficacy of Purgatives, is after some hours violently carried into the Dugs, as divers Experiments do teach. Yea and our Country-women, when children that have the cough, suck at their breasts, they drink peccoral Decoctions, and believe that the sucking child does presently draw them.

2. If a Nurse do swallow an hair in her meat and drink; it comes into her Dugs according to *Aristotle*, and sticking in the Nipples, it causes the Disease *Trichiasis* or Hair in the Nipple.

3. A branch of Cichory according to the Observation of *Martianus*, hath come out of a womans Dug, which she had eaten the night before at Supper: and bran hath been seen in the Excrements of a child that only lived with sucking.

4. Nurses perceive as soon as ever they have eaten and drunken, the going down of the Milk, and the swelling fulness of their Dugs. Yea, and our Nurses are extraordinary careful not to eat, while they give their children suck; for otherwise the children should suck undigested Milk.

5. *Castellus* pleads their Situation over the Stomach, not near the Liver or Womb, excepting in beasts.

6. The Milk is colder then the Blood, and leaves more Excrement in her that gives suck, then blood does in the Embryo or child in the womb.

Howbeit we find many difficulties in this new Opinion, and those of no small moment.

1. There are no manifest passages from the Stomach to the Dugs, which if any man can find, I shall willingly acknowledge my self convinced. *Martianus*, indeed, *Castellus*, *Veslingus*, and *Horsius* do talk of invisible

The said Opinion refused.

passages, like the milkie Veins, which cannot be discerned in a dead body; or at least they conceive the Pores of the flesh may suffice to admit a passage for milkie Vapors. But the Pores seem too narrow for thick Chyle to pass through, which in the Mesentery did require large milkie Veins, which any body may discern. A subtil Spirit and thin Vapors with smooke steamis, do pass through the Pores, and not the Chylus, nor blood, according to Nature; for if so, then there were no use of Vessels. Nor is the Infant satisfied only with Vapors. I willingly acknowledge, that Nature endeavors the translation of Humors from one part to another by unknown wayes, but she does it compelled, and besides her customary Course, whereas the breeding of Milk is a constant and ordinary thing.

2. The Dugs being heated by any other cause whatsoever, do not breed Milk, but the action is hindered by the said Heat.

3. Nurses contest, that after they have drunk, the Milk does manifestly descend out of their backs, and from about their Channel-bones, and puts them to some little pain. For there the Chest-arteries are seated, and not the Stomach.

4. A tender Infant should be ill nourished with undigested meat, having been used to be nourished with blood before.

5. Out of the Nipples of Children newly come out of the Womb, before the use of meat, a wheyish matter drops like Milk, before they have eaten any meat.

6. What shall we say to that *Aphorism of Hypocrates*?

If a Woman want her Courses, nei her any shivering o Fever following thereupon, and she loath her Meat: Make account that she is with Child.

7. Cows, when they eat grafs after hay, or hay after grafs, before the fifteenth day, there is no perfect change either in the Constitution or colour of their Milk or Butter, according to the Observation of *Waleus*; yet they perfectly change their Chyle the first day, but their Blood more slowly. Also our Nurses observe, that after they have slept, and their Meat is digested, their Dugs make Milk, which does not so happen, if they want sleep.

8. *Hogeland* proves by Famines and Seiges, that when all the Nutriment of the Nurse is turned into perfect blood, yet nevertheless Milk is bred in the Dugs.

And the Argument of Martianus and others are answered.

Wherefore until some diligent hand shall have found evident wayes and passages, for the Answering of the contrary Arguments: You are to Note. 1. That we admit of the Chyle as the remote matter of Milk, but not as the immediate matter thereof. 2. That the Blood being plentifully evacuated by the Milk, is bred again by plentiful meat and drink; and therefore the plenty of Milk ceases when there is little drink taken in, as all Nurses do testifie. Moreover, such as are of a Sanguin complexion afford most Milk, whereas those that are of a tender constitution grow lean by giving Suck. 3. That all the blood which is poured out of the Arteries into the Dugs, is not turned into Milk, but only the more wheyish part, a great deal running back by the Veins into the Heart. 4. That Women which give suck have their Courses, because the Vessels of the Womb are then more enlarged, then in the first months of their going with Child; and ever and anon they flow sparingly from Nurses, and leave off by fits. Also Women that give suck seldom conceive, unless they be of a Plethorick habit of body, that is to say full of good blood. Our Women when they would wean a Boy, if their Dugs swell, they do by certain Medicines keep back the Milk, by straitning the Vessels, that the matter thereof may not enter nor be drawn that way. 6. That the Breast and Dug-Arteries are large, and are more and more widened by continual sucking. 7. That the Milk doth drink in the faculty of Meats and Purgatives, even by mediation of the Blood, which conserves the color and faculty of the meats, though sundry digestions have preceded; though vapors alone be raised, and the substance ascend not. 8. That many things are performed in the body, according to the singular constitution of particular persons, yea and many things which rarely happen, which is to be understood of the Milk, which was in the Dugs of that *Man at Cows*, and of other things thence voided.

Their Nerves.

Nerves are carried from the Nerves of the Chest, especially the fist, for to cause sense, and they end in the Nipple.

Their Pipes.

Besides these Vessels, the Dugs have also white Pipes, according to the observation of later Anatomists, springing from the whole Circumference of the lower part which growing narrower, do alwayes meet together, wherein Milk being made, is preserved for use. Whether or no they are nothing but widened Arteries, becoming white, because of the change of the milk and the bordering kernels (which I am willing to believe) I leave to acuter Eyes and Wits to determine. They treasure up the Milk, when there is occasion of omitting to give the Infant suck: and when that use is over, they grow as small as the most Capillary Veins.

Their Use is, 1. General in Women and Men, to be safeguards to the Heart: hence Nature hath given Men of cold Complexions larger Dugs then ordinary; and Women that loose their Dugs become rough-voiced, according to *Hypocrates*. Nor doth the pectoral Muscle hinder, which performs the same Office, which is *Riolanus* his Objection; for the more noble parts require great fencing, even by the smallest things, as the Eyes from the Eye-brows, the Heart from the water in the Heart-bag or Pericardium, &c.

The use of the Dugs.

II. In women their use is to breed Milk, to nourish the young Infant. For the Child was nourish by blood in the Womb, and milk is the same blood only whitened, so that Nature seems to have put a trick upon living Creatures by obtruding upon them the gentler appearance of white milk, in place of red blood, as *Plato* hath it. Which is the Cause that the People of *Savoy* and *Danphine* did anciently prohibit their Preists, the use of milk, as well as of Blood.

Now the Efficient Cause of milk, is not the Womb, where milk was never observed, nor do the Dugs breed milk, by that virtue thereof which it self wants; nor of the Veins or Arteries, unless it be the nearest, can the virtue be communicated from the Dugs. For as for what *Baronius* relates of *St. Paul*, how when he was beheaded, not blood but milk ran from his Neck, either it was a miracle, if true; or a serous humor flowed out, which sometimes flows from the Arm, when a Vein is opened, and I have seen it very like to milk, or finally the Liquor of Kernels being cut, did resemble milk. But the true efficient cause of the milk, is that same kernely flesh of the Dugs, unto which there is none like, in the whole body. Now it works this moderate Concoction by the propriety of its substance, and by reason of its proper temperament. *Aulus Gellius* conceives the milk becomes white, by Reason of plenty of heat and spirit Book 12. Chap. 1. But I am more enclined to believe, that milk is white, because it is assimilated to the Dugs that are of the same color.

The Efficient cause of Milk.

Sometimes therefore (though it happen seldom) milk may be bred in Virgins, and in Women not with Child, according to the Observation of *Bodinus* in his Theatre of Nature, of *Joachimus Camerarius* in *Schenkijus*, of *Petrus Castell.* touching one *Angela* of *Messina*, of *A. Benedictus* and *Christopher a Vega* concerning a Girl of *Bridges*, and of others. In *Scania* in our Country, a maid was lately accused to have plaid the Whore, because she had milk in her Dugs, which nevertheless she proved to be a propriety of her Family, by producing her young brother who likewise had milk in his Breasts. Infants new born shed a wheyish milky liquor out of their Nipples. These examples are confirmed by the Authority of *Hypocrates* in the 39. Aphorism of his fifth Section, where Women have milk though neither with Child, nor lately delivered. And this happens, when the Dugs are filled with abundance of spirituous blood, and suppression of Courses be joynd thereto: for then the Glandulous substance digests more then is necessary to nourish the Woman. Yea, in men that are fleshy, large-dug'd, and cold of constitution, a milky humor, and as it were milk is frequently seen; especially if their Nipples be frequently suck'd, and their Dugs rubbed, as the

Milk may breed in Virgins, Men, Women not with Child, &c.

the examples of many do testify. *Aristotle* writes of a certain Hee-goat in *India* and *Scythia*, who yielded so much milk, that *Cheese* were made thereof. *Matthiolus*, tells us that in sundry places of *Bohemia*, three Goat-Bucks were found, that gave milk, by which persons that had the Falling-sickness were Cured. Others have seen Men, out of whose Dugs store of milk came. *Aben-sina* saw so much milk milked from a Man, that a Cheese was made thereof. *C. Schenkijus* relates that *Laurentius Wolfius* had store of milk in his Breasts, from his youth, till he was fifty years old. *Jo. Rhodius* had such an Host in *England*, and *Santorellus* knew a *Calabrian*, who his Wife being dead, and he unable to give wages to a Nurse, did nourish his own Child with his own milk. *Walaus* saw a Flemming of like Nature, who being even forty years of Age, could milk abundance of milk out of huge Dugs which he had. *A. Benediclus* relates the story of a Father that gave his Son suck. And *Nicolaus Gemma Vesalius*, *M. Donatus*, *Agua-pendens*, *H. Eugubius*, *Baricellus*, do witness the same thing, and I have already told you as much of a Boy of *Scania* in our Countrey of *Denmark*, and *Cardan* saw a man thirty four years old, out of whose Dugs so much milk did run, as would have sufficed to suckle a Child. They relate how that in the new world, all men well-near abound with milk. Now that this was true milk which we have related did run from men, is hence apparent because, it was as fit to nourish children, as that of Women.

III. The use of the Dugs in Women is to adorne them, and render them the more delectable to Men.

IV. They serve to receive Excrementitious moisture. Whereupon their Dugs being cut off, Women incur sundry Diseases; because the blood which ascends finding no Vessels to receive it, runs hastily into the principal parts, the Heart, Lungs, &c. Which danger I conceive the *Amazones* did study to avoid, by their so vehement exercising themselves in warfare. Some cut the Dug off when it is cancered, but the operation is dangerous, by reason of the bleeding which follows.

CHAP. II.

Of the Intercoastal, or Rib-between Muscles.

See the Figure of the following Chapter.

Sundry Muscles which we meet within the Chest shall be first of all explained in the fourth Book, by reason of the Method of Section. But the Intercoastal or Rib-between Muscles, so called; because they are interwoven between the Ribs, must be explained in this place.

Their Number. Now they are totally fleshy, forty four in number, on each side two and twenty; eleven external; and as many internal. For evermore between two Ribs, two Muscles rest one upon another: and there are eleven

The Error of others. Intervals or Spaces between the Ribs. Others have done ill to make their Number sixty eight. For in the Intervals of the true Ribs, they have made divers Muscles lying hid between the boney parts of those Ribs, differing from those which are found between the Gristle parts.

The External ones arise from the lower parts of the upper Ribs, and descending obliquely towards the back-parts, they are inserted into the upper parts of the lower Ribs. The Internal contrarywise.

The External end at the Cartilages: The Internal fill the spaces, both of the Ribs and Gristles.

They have oblique Fibræ and mutually cross one the other like this *Letter X*, because the Muscles are otherwise short, because of the smallness of the Intervals. Hence in the opening such as have a suppuration in their Chest, Section is to be made straight according to the Course of the Fibres, not overthwart.

They have received sundry Vessels. Veins from the Azygos and upper Intercoastal, Arteries from both the Intercoastals. Nerves from the sixth pair; joyned to them which proceed from the Marrow of the Back.

Their use, is to Dilate and Contract the Chest; the external imitate the drawing of the Subclavius: By raising the Ribs, and straining the Chest, and help towards Expiration. The internal draw away the Ribs, and by enlarging the Chest help the Drawing in of the breath. *Galen*, contrarywise, makes the external serve for drawing in, and the internal for blowing out of the Air, whose opinion is favored by *Veslingius*.

Others with *Vesalius*, will have the external Muscles to thrust the lower Ribs upwards, and the internal ones to draw the upper Muscles downwards, that they might so mutually assist one another in straining of the Chest. But we should rather think, that when the Internal ones are quiet, the External do act by themselves.

Fallopins, *Arantius*, *Riolanus*, do account them only to be fleshy Ligaments of the Ribs, whereby they are knit one to another, because the Ribs cannot be moved of themselves, save by the Muscles of the Chest. But the Thorachick or Chest Muscles being unmoved, the Ribs are often moved by help of these Muscles, receiving some impulse also from the Diaphragma or Midriff. The Ligaments of a Muscle are never bare. The Ribs may be fastned one to another, and likewise moved by these, which is common to all other Muscles. However the motion of the Ribs is obscure, because they are inarticulated in one part only, and the parts between the Ribs are narrow; But their Number supplies their smallness.

Chap. III. Of the Diaphragma or Midriff.

The DIAPHRAGMA or Midriff, is so termed from distinguishing or separating, some term it *Præcordia* because it is ordinarily stretched out before the Heart, and *Phrenes*, because it being affected, the Mind and Sense are disturbed by reason of the Consent it hath with the brain, so that when the Midriff is inflamed a *Paraphrenia* or petty Phrenzy is caused. The Cause of this consent is very doubtful. *Hippocrates* saies, the Heart becomes foolish through blood flowing back unto the Heart and Midriff, from the multitude thereof, which foolishness makes it dull and nummed as it were, and that nummedness makes it Phrenetic. But the more firm experience of latter Physitians, hath proved that the brain and not the Heart, is the seat of Madnests. *Aristotle* attributes

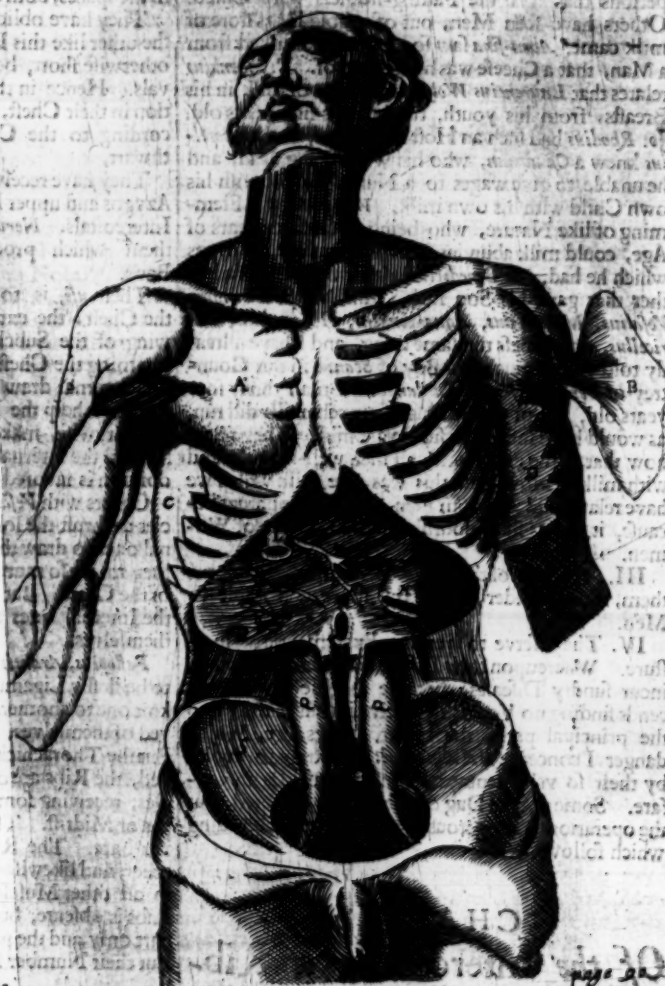
The Diaphragma or Midriff, why so called.

The Explication of the FIGURE.

This Figure presents the External proper Parts of the Breast, also Delineates the Situation of the Midriff in the Body.

- A. The Pectoral Muscle in its proper place.
 B. The same out of its Situation.
 C. The Muscle Serratus major Anticus, or Greater-fore-side-Saw-muscle in its own place, being partly visible.
 D. The same out of its place.
 E. The Serratus anticus minor, lesser fore-side-Saw-muscle.
 FF. The Claviculae or Chanse bones.
 G. The Subclavian Muscle.
 HHH. The Intercostal, or Rib-between Muscles.
 III. The Diaphragma or Midriff.
 K. Part of the great descendent Artery.
 L. An Hole for the Vena Cava descendens.
 M. An Hole for the Gullet passing through the Diaphragma.
 nn. The Venae Phrenicae or Phrenick Veins so called.
 oo. The Phrenick Arteries.
 pp. The two Appendices or Appurtenances of the Diaphragma.
 QQ. The Muscles termed Ploas.
 RR. The Musculi Quadrati or square Muscles of the Loynes.
 SS. The internal Cavity of Os Ilium, or the Flank-bone.

The I. TABLE



prudence to the midriff, and when it draws out of the neighboring Liver and Heart Excrementitious Humors, the mind is thereby hurt, and the external Senses. Yet, Neither doth he solve the doubt, for many other parts draw like Humors, without causing madness; nor doth he unfold, how the Midriff imprints these ravings upon the Brain. The consent of Vicinity makes nothing to the purpose, because it is nearer other parts, nor society in the same Office, because the Lungs being diseased in a *Peripneumonia*, do not cause a *Delirium*; nor finally, the communion of Nerves and Vessels, because in the Inflammations of other Nervous parts no such thing happens; *Cassius* doth therefore necessarily flie to an occult consent, peculiar to this part alone. Others term it *Septum transversum* from the Cross-partition, because it goes cross, and divides the Body, and separates the middle

belly from the lowermost. Some call it *Cinetus*, *Disseptum*, *Discretorium*, and the Greeks also call it *Zone*, *Diagoma*, *Perizoma*, &c. Now it is a singular and peculiar kind of Muscle, having an action and figure differing from all others.

Its Situation is overthwart, or across the body, and because it enclines a little downwards, oblique.

Its Figure is circularly round, saving the long Appurtenances.

This Muscle is in Number only one, because of the unity of its Action common to both sides, but it is a great one. *Meyssonerius* saw a double Midriff at Lyons.

Its Magnitude answers the Diametral wideness of the lower Belly, which is comprehended

What it is?

Its Situation.

Its Figure.

Its Number.

Magnitude.

comprehended between the lower Vertebra's of the back and the Ribs. Hence great and whaley flesh, because they have longer and more Ribs then we have, have a larger midriff, creeping mean-while as far as to the extremities of the Ribs. For,

An Head and Tail in the Midriff. For it seems to arise from the Vertebra's of the Loyns, by two somewhat long fleshy parts (which cleave to the muscles of the Loyns, at the sides of the great Artery, and growing by little and little wider, about the lowest Vertebra's of the Chest they grow together, where this Muscle begins to grow Circular) and is fastned to the Chest round about, being knit where it is fleshy to the extremities of the Ribs: though we should do peradventure more rightly, to make the beginning thereof, in its whole Circumference, as well from the Loyns as the Ribs, which *Galen* doth also somewhere insinuate: For seeing it could not be knit to the eleventh Vertebra, because of the great Artery, and the beginning of the Lumbal muscle, it is strongly infered, by its two final appurtenances to the Vertebra's of the Loyns.

Galen somewhere (whom *Sylvius*, *Vesalius*, *Aquapendens*, *Spigelius* and many more follow) will have the middle of the *Diaphragma* to be the Head thereof, because the Nerves are there inserted, and the Centre in a Circle, upon which one point of the compass doth rest, while the other is carryed about, may be well taken for the Head of the said Circle. But as it is a peculiar muscle, in Situation, Action, Figure, Nobility, &c. so hath it somewhat peculiar in this point. But the beginning or Head cannot be in this Centre, because it is moveable, and the Ribs and Vertebra's of the Loyns, in respect thereof immovable. Moreover, the Nervous or Tendinous part, is the End of the muscles, and not their Head.

Its Substance. Its Substance is fleshy, in the middle Nervous and Membranous, where a Membranous Centre shews it self and a Nervous circle in stead of a Tendon, to which fleshy Fibres do run, from the Circumference of the Chest, as to their Centre. Whence necessarily the middle part of the motive muscle is Nervous, for otherwise it could not be moved. *Secondarily*, it helps to strength, in a perpetual motion, and in the suspension of the bowels which adhere thereunto; moreover it serves to secure the Vessels which pass through. To sustain the beating of the Heart, it was not to be strong, as *Riolanus* suspects, because 1. A soft part doth easily give way and yeild to a blow. 2. The point of the Heart doth not strike against the Midriff in its pulsation, for the Heart smites the breast when it is erected in the Systole, and is contracted at the sides; in the Diastole when it descends to the Diaphragma, it becomes soft and flabby, and gives no pulsation.

Note that Wounds in the Nervous Centre of the Diaphragma, are by all accounted deadly, whether because a Nervous part being offended, doth induce a Convulsion, or because it cleaves to the Pericardium or Heart-bag and to the Liver, or because respiration perishes, and the Heart placed over the same is likewise hurt; for the Pericardium and Liver being hurt, do admit cure. A wound is more safely made in the fleshy Circumference thereof.

Its Membrane. It is clothed with a double membrane, for strength. The upper is from the Pleura, to which the Pericardium or Heart-bag is firmly fastned, and sometimes also the Lobes or Laps of the Lungs by little small Fiberkies; the lower is from the Peritonæum.

Also it hath its proper substance, formerly described.

It hath Holes: some being very exceeding little, and others great. Those very little ones are the Pores, through which vapors arise from the inferior parts. They are widned by the perpetual motion of the Diaphragma, not by Odours and Fumes, as *Helmont* believes. Otherwise, because the Membrane is thick, it hinders the drinking in of thick vapors, and will not let them ascend without the Vessels. Among the greater, there is one on the right hand, in the middle of the Nervous part, to give a passage to the Vena Cava: Another on the left hand greater and somewhat backward, for the letting through of the Gullet or Oesophagus with two Nerves which go unto the Stomach. And where it arises about the Vertebra's of the Loins, there appears a division, for the through-fare of the great Artery, and the Vena sine Pari, or Vein without fellow. These wide holes do admit from the inferior parts, the passage of thick Vapors with the blood, which cannot be prohibited by the Diaphragma. Hence in the 29. Aphorisme of the first Section 'tis said, in a Fruitful Women, her lower parts being perfumed, the scent goes up to her Nostrils.

As to its Vessels. It has Veins and Arteries from the Neighbouring Vessels vena cava and Arteria magna, called Vena phrenica: and sometimes from the Vena adiposa.

Nerves are spread through its whole Substance, being brought from the spinal marrow of the Neck, between the fourth and fifth Vertebra: which is proper to this part, and common to no other internal part under the Channel bones, because according to the Conjecture of the renowned *Hofman*, it was not to lie open to external wounds or Blowes, least we should be masters of our own Life or Death. But instruments of death are every where obvious, which the Love of Life and Fear of God hinders us from making use of. Now they are carried through the Cavity of the Chest, and are propped up by the mediastinum. Other Anatomists have observed other Nerves passing that way from beneath, proceeding from the costal and stomachick Branches. And because the Nerve of the Diaphragma or Midriff are in their passage mingled with certain little twigs, which are spread abroad into the muscles of the Jaws and Lips; hence when the Diaphragma is smitten there arises a kind of Laughter, which is no real Laughter, but a counterfeit one. such as they call *Risus Sardonius* the Sardonian Laughter, because the muscles of the Face suffering a Convulsion at the same time, and the Jaws and Lips being moved this way and that way, the partie seems to laugh. Such was the laughter of *Thyenis* in *Hippocrates* and of *Agnerius* in our Countryman *Sarco* his relations, who was cut asunder in the middle with a sharp sword: also of that man in *Aristotle* whose Midriff being in the fight pierced with a Dart, made him die laughing. *Pliny* relates as much of other Fencers, and *Homer* tells us that *Juno* laughd with her Lips when her Forehead scowled.

Galen makes the Cause of the Sardonian Laughter to be in the Musculus latus quadratus, the broad square Muscle. But it reaches not to the Lips, *Laurentinus Pollitianus*, makes the spirits to be the cause of this Convulsion, which because of the sense they have of some troublesome thing, run back to the upper parts. *Mancinius* will have the Heart to be widened, and the face drawn into the posture of laughing, by the hear which

Its Holes.

Vessels.

Sardonian Laughter.

is raised by tickling and wounds, because he will have the Heart to be the seat of Laughter, in defence of *Aristotle* whom Physicians have confuted. *Riolanus* has sometimes observed laughter to arise in the guelting of a man, which was the forerunner of a deadly Convulsion; for which cause he condemns our reason drawn from the Nerves, not giving us in the mean time any better reason viz. why laughter should arise upon the wounding or hurting the nerves of the Midriff and Privities, and not when any other nerves are wounded.

Use. Its Use is 1. To help free Respiration; for violent respiration is assisted by the muscles of the Chest; the former Respiration *Galen* terms gentle or small, which depends only upon the Midriff, the other strong, the intercostal muscles assisting thereto, a third sublime, where the Diaphragma, intercostal or rib between muscles, and muscles of the Chest do act all together. *Birds* indeed, though they breathe have no Midriff, but their breathing which is light and scarce perceptible, because of the lightness of their bodies, is performed by their Lungs and Chest. Contrariwise *Fishes* which breathe not have a Midriff, but membranous, to separate one Belly from another. In the greater sort of Sea fishes of the whaley kind, I have observed a fleshy Midriff like that of Creatures which live on the Land.

How the motion of the Diaphragma is performed.

Now the motion thereof is thus: when the Breath is drawn in, the Midriff is stretched, when it is blowne out, it is remitted or slackened, contrary to the Opinion of *Avicenna* and *Laurentius*. Of whom the latter will have the Midriff contrary to all other muscles to draw towards its end; and he will have the fibres which run out from the Circumference of the Chest, to be equally contracted, and the ribs to be drawn to the nervous Circle, and so to cause respiration. But how can the membranous Centre of the Septum, draw the ribs to its self and contract the whole Chest unless haply because it is fastned to the Mediastinum. But I have observed more then once in dissections of living Bodies, that the Midriff is stretched out, when the Creature draws in its Breath. For the Guts are driven downwards by the Midriff when the Breath is blown out, and they ascend again when the Breath is drawn in, which also any man without Anatomical Section, may perceive in himself, by laying his Hand upon his Belly. In Wounds of the Diaphragma, the Guts and Stomach, when the Breath is drawn in ascend into the Chest, which *Paracelsus* twice observed, which differs only according to more or less, from the naturall course of breathing. Now the motion of the Midriff ought to be such, because the Chest when the Breath is drawn in, must be widened to receive and contain the Air and swoll Lungs; and contrariwise, when the Air is breathed out, the Chest ought to be straitned, because then the footy vapours are expelled, and the Lungs flag and become small again, and therefore in the former case the Midriff is lifted up, and in the latter depressed.

Jo. Waleus besides that motion, whereby the fleshy part gives way inwardly, has observed another motion in the Diaphragma during the drawing in of the breath, whereby the fleshy part thereof being contracted into it self, comes to have folds in it, so that one portion of the fleshy part is placed upon another: and he observed that this folding is chiefly about the Appendices or Appurtenances, and when the breath is

strongly drawn in: and he conceives that by this means the Midriff is the more shortened, and the Chest by the lifting up of the Ribs, more widened.

II. To assist the muscles of the belly, in their compression, when they would force out the Excrements and the Child in the womb: for from above it thrusts the Guts downwards. Hence, according to the Observation of *Platerus*, when the belly is colicive, Sneezing and Coughing do help, because thereby the Midriff and Dung contained in the Guts, are driven downwards, because of the Strugling of the said Midriff and its bearing down, the Excrements of the belly and Urine come away of themselves in live Anatomies and in such as are put to death by hanging.

III. To distinguish the lower belly with the natural parts, from the middle belly with its vital parts, least from the Ignoble parts frequent vapours should ascend, to the parts more noble, as the Heart. &c.

IV. According to *Hippocrates*, it is the Fan of the lower belly, which fannes and cooles the *Hypochondria* or parts under the short ribs.

V. Others suppose it causes natural respiration, becaue it depends not upon our will and pleasure, and moves when we are asleep, and never so much as think of it, and by help thereof, Men in Apoplexies do for a season breathe. But *Piccolomannus* does more rightly assign a voluntary motion thereunto, howbeit only when some necessity constrains, as in easing of the belly, pissing, and fetching of breath, because it is a Muscle of a nature by it self; but not a motion absolutely or simply voluntary, which is discerned in progression & apprehension, that is to say in going and handling.

Its motion ceases in a strong Apoplexy, only transpiration does then remain: but in a light Apoplexy, we see the Diaphragma also moved with the Chest muscles.

CHAP. IV. Of the Pleura, Mediastinum, and Thymus.

THE PLEURA or Rib-coate, which the Greeks call *Chiton hupexocōs*, or absolutely *burnēn*, is a membrane which on the inside clothes the cavity of the Chest, hard and white, but in some pleurētick persons according to *Hippocrates*, black and blew, whence it is that Practitioners conceive that this is affected in the Pleuritis, which notwithstanding is demonstrated to happen secondarily, by *Manesphus*, *Cletus*, *Platerus*, *Zacchius*, *Vitaglianus*, *Benedictus*. It is somewhat thicker and stronger then the Peritonæum. Arising from the Coats, which cover the intercostal nerves which proceed out of the Backbone, by means of which it is continued with the Coats of the Brain. And therefore it is thicker in the Back, to whose vertebra's it cleaves as it were inseparably. *Hofmannus* will have it arise from the Breast-bone rather than the vertebra's of the Back, wherein he is out, as I have proved in my *Animadversions* upon *Hofman*, and in my *Anatomical Colledge*. In diseases of the Chest, it becomes many times ten-fold thicker: though others say it is so attenuated in pleurētick persons, that it can hardly be discerned. *Fallopianus* saw it of a thick callous substance, in a Dropic of

What the Pleura is, and its Original.

Its Thickness.

of the Lungs, and *Plastrum* saw it in like manner swoln by a Scirrhous Tumor.

It is every where ~~double~~, that the Vessels may be carried within the folding thereof. The outer part

The place of the matter which causes a Pleuritis.

which looks towards the Chest, is harder and thicker, the inner part being fastned to the Ribs is thinner. Between these the matter of the Pleuritis is often collected, and not only between the Pleura and Muscles. *Galen*

makes it to be single, and will allow it to be double, only about the Mediastinum. *Riolanus* explains that same Duplicature to mean its thickness, which cannot be shewed without tearing. The contrary whereto is manifest in the swoln sides of such as have the Pleuritis.

It hath its inner surface smooth, least it should by its roughness hurt the Lungs; its outer more rough that it might be the stronger fastned.

Sometimes it is found furnished with a little fat (as there is also now and then in the Peritonæum) near the Vertebra's of the back, where the Vessels are greater then ordinary.

The Ribs also have their *Periostium* or Membrane so called, which some call the third coat of the Pleura, and others *Membrana Circumossalis* the bone-about Membrane.

It hath very many Holes, the lower- *Its Holes.* more of which I have reckoned up in the History of the *Diaphragma*, the upper are there where it affords passage to the *Vena Cava*, the *Arteria aorta*, the *Wezand* or *Aspera arteria*, the Gullet and the Nerves of the sixth Pare.

As for its VESSELS. It hath *Veins* from the solitary *Vein* or *Vena sine Pari*, and the upper Intercoastal or Rib-between *Vein*; *Arteries* from the Intercoastal or Rib-between *Artery*, and from the great *Artery*; *Nerves*, twelve in number, proceeding from the fore-side of the Vertebra's of the Chest. And therefore wounds in this part are attended with most grievous pains.

ITS USE is. I. According to *Galen* to plaster over the whole Cavity of the Chest and to render it smooth and even, that the Lungs might not be hurt in their motion. 2. To cloath the Chest and its parts on the inside (even as the Peritonæum affords coats to the parts of the lower Belly) and to constitute the Partition Membrane. Or,

MEDIASTINUM, Which is an off-spring of the Pleura, being a double Membrane; separating the Cavity of the Chest and the Lungs into two parts. For after that the Pleura having taken its Original about the Back hath ascended by the sides to the Breast-bone, taking its course again towards the Back-bone, it is carried right out from the middle of the Breast to the Back. Being fastned on each hand to the sides of the Breast-bone, this Membrane is not obscurely double, as is the Pleura, but visibly, being constituted of the Pleura doubled; and there seems at first sight to be as great a space between both, under the Breast-bone, as the breadth of the Breast-bone comes to. But this is only in appearance and not really so; for that same Cavity under the Breast-bone, is then only ~~caused~~, when the Breast-bone is in dissection, plucked from the Mediastinum, for before the Membranes of the Mediastinum are most closely united one to another. Which it is strange that no Anatomist did observe before *Ad Falcoburgius*. After him, I have often made the Experiment, in grown persons and Children new born, in Land-beasts and large Sea-fishes; nor could I shew any Cavity betwixt the

Mediastinum and Breast-bone, no not to the most expert Spectators, but I found the Membranes of the former sticking close by certain Fibres to the latter, which we forcibly separated with a Penknife. Which that it might be more apparent, the inwards of the Belly and the Midriff being taken away, I made it visible to the Eyes of all that were present. These things are to be understood of the lesser Cavity (to satisfy *Riolanus* who is my Adversary in this point) between the Membranes of the Mediastinum and the Sternum: For the greater, wherein the ever-moving Heart is seated, no man in his right wits will ever deny. In this greater Cavity, or in this Duplicature if a wound inflicted on the fore-side shall penetrate, lightly, so that the Heart settling beneath remain unhurt, it is sufficiently void of Peril and safe enough; which one unskillfull in Anatomy would pronounce deadly. But towards the Vertebrae, the Cavity grows narrow by little and little, and the Membranes meet together. But in the middle the Cavity is wider, and in the fore part of the said Cavity, the Heart and *Vena Cava* are placed; in the latter part the Gullet, with the Stomach Nerves. If in this Cavity humors præternaturally assemble and putrifie, they may safely be let out by boring an hole in the Breast-bone, if we believe *Columbus* and *Hofmannus*, which *Nicolas Fontanus* doth notwithstanding deny.

It is of a thinner and softer substance than the Pleura; and about the Vessels *Its substance.* tis frequently full of fat like the Call.

For Vessels, it hath *Veins* and *Arteries* from the Dug-vessels and the solitary *Vein* or *Vena sine Pari*, applied inwardly to the breast-bone, which being taken away they become visible: Also it hath its own proper *Vein* called *Mediastina*, which is sometimes one and large, other whiles double and small. *Vessels.*

Also the Phrenick and Stomachick Nerves are carried through this Duplicature, and afford branches to the Mediastinum.

The use of the Mediastinum is, I. To divide the Chest into two parts, that *The use of the Mediastinum* one Division of the Lungs being hurt by a wound or otherwise, the other might perform its office.

II. To hang the Heart and Heart-bag dangling in so free a posture, as to strike against no part of the Chest.

III. To sustaine the Vessels running through the same, as also the Midriff in Mankind, least it should by the weight of the Bowels be drawn too much downwards.

The Thymus grows thereto in the Jugulum or Throat-pit the highest part *The Thymus* of the Chest, whereunto in ordinary what it is? Anatomical Figures it is fastned, and hath its name from the leafe of time which it resembles, not from *Thymus* the Mind, as if in disturbances thereof by passion, the blood and Spirit should work or grow hot within this Kernel, in the *Vena Cava*, as *Riolanus* interprets the meaning of the word; for the blood grows hot in the Heart, here it hath only a passage and carries not, seeing few branches are discernable in the body of the Thymus, unless somewhat be left by the Arteries for Nutrition sake. In children and the Embryo in the Womb, less subject to passions, the Thymus is greater and more Numerous, in persons of ripe years who are soon angry, we find it dried and contracted. Now it is a kernellish, soft, spongy, and when some (some term it the Sweet-brad, be-

The FIGURES Explained.

This TABLE represents the Brest-bone cut off and lifted up, also the Mediastinum and the Lungs, with the Midriff.

FIG. I.

- AAA. The inner surface of the Brest-bone and the Gristles interwoven therein.
 BB. The Dug-Veins and Arteries descending beneath the Brest-bone.
 C. The Glandulous Body called Thy-mus.
 DDDD. The sides of the Mediastinum plucked asunder.
 EE. The distance between the two Mem-branes of the Mediastinum which is caused by its forcible separation from the Brest-bone.
 F. The Protuberancy of the Mediasti-num, where the Heart is seated.
 GG. The Lungs.
 HH. The Midriff.
 I. Cartilago Ensiformis, the Sword-like Gristle.

FIG. II.

- A. The left Nerve of the Midriff.
 B. The right Nerve thereof.
 C. The upper Membrane of the Midriff a little separated.
 D. The naked substance of the Midriff.
 E. The Hole for the Gullet to descend through.
 F. The hole or the Vena Cava.
 GGG. The Membranous part, or Centre of the Midriff.
 HHH. The Portions or Appendices thereof, between which the great Artery descends.

FIG. III.

Represents that same Glandulous Body, seated by the Larynx.

- AAA. The Glandules or Kernels which naturally breed upon the Larynx.
 B. A portion of the jugular Vein, out of which two small twigs proceeding, do spread themselves through the substance of the Glandules or Kernels.

cause in a Calfe 'tis counted a dainty bit). In a Child new born 'tis distinguished into a threefold Kernel sufficiently big. In grown persons, 'tis extenuated, its moisture being consumed by heat. Howbeit I have seen it large in great Sea-fish, from which many other Kernels were diffused on either hand, about the Mediastinum and sides of the Lungs.

Blood-conveighing Vessels do pass through this Thymus or Sweet-bread; howbeit in the substance thereof, being dissected, we cannot manifestly discern any.

The use therefore of the Thymus is I. To under-prop those great Vessels which ascend that way, as the Vena Cava, Arteria magna, and their branches passing

The II, TABLE



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along to the Arms and Shoulder-blades. 2. Also for safeguard, as is usual, and that the Vessels may not be hurt by touching upon the bones. 3. That it may be as it were a cover and fence for the Heart, for I have seen it as a Bulwork to the Heart, which the Heart of a Child in the Womb stands in need of, because as yet it stirs not. And therefore it hath a large Thymus, as a Surgeon also hath and other Creatures which live in the Water, by reason of the external cold.

CHAP.

Chap. V. Of the Heart-bag and the Humor contained therein.

The Pericardium.

See Tab. 3. of Book 2.

THe Pericardium which some term the Coat, Case, Box, Chamber, Cover of the Heart, or Heart-bag, &c. is a Membrane compassing the whole Heart, whose Figure it therefore Emulates, as also its Magnitude: But it is so far distant from the Heart, as is necessary for the Hearts motion, and the reception of the Liquor contained in this Bag. *Columbus* assures us, that a Scholar of his had no Pericardium.

Its Original. It arises at the Basis from the Coates which compass the Vessels of the Heart, which proceed from the Pleura (for this Coat is not between the Basis of the Heart and the Pericardium) where for their sakes.

Its Holes. It hath five Holes; viz. for the ingate and outgate of the *Vena Cava*, and for the letting out of the other three Vessels.

Situation. Its Situation is more to the left side then the right; and more to the fore then the hinder part of the Body.

Its Connexion. It is knit circularly to the Mediastinum, with very many Fibres, and to the neighbouring parts, but especially the Nervous circle of the Midriff, it cleaves exceeding close, which is a thing peculiar to Mankind: For herein a Man differs from Dogs and Apes, and in all other Creatures likewise, the difference holes.

Its Surface. Its External Surface is Fibrous, the Internal slippery, and both void of fat.

Its Substance. Its Substance is thick and hard, and so much harder then the Lungs, as it is softer then a bone.

Its Vessels. Its Vessels. It hath small Veins, below from the Phrenick Vessels, above from the Axillary.

It hath no Arteries that can well be seen: peradventure, because it is so near the Heart. Yet doubtless it hath some although hard to be discerned.

It hath very small Nerves, from the left Recurrent, and the little twigs of the Septum.

Its Use. Its Use is I. To be a firme tabernacle for the Heart, that in its motion it might not strike against the hard parts of the Body.

II. To contain a wheyish or Warry Humor, like Urin to see to, though neither sharpe nor Salt, transparently clear, in some like water, wherein flesh hath been washt; *Guil. Toletus* in *Burgensis* calls it a flegmatick Humor of an unpleasing tast. And because of this Liquor *Galen* resembles the Heart to a Bladder.

Whether all Livers have this wheyish Liquor in their Heart-bags. This Humor is found in all Animals naturally constituted, both living and dead, yea and in the Child in the Womb, as appears by the dissection of bodies both living and dead: But in some more in others less; in persons that are in a Consumption, it is very little and inclining to yellowness. In persons Pleuritic it is now and then of a quit-torish nature, according to the Observation of *Salmuth*.

Why more plentiful in dead Bodies. In dead bodies tis more plentiful: Because then very many Spirits are in the cooled parts of the body condensed into water. In Women,

Children, and aged persons, tis more plentiful, by reason of the debility of their heart.

If it happen to be in two great a quantity, Palpitation of Heart, and a suffocating death follows therefrom: if it be quite consumed, a Consumption of the body happens. But that it may be bread a fresh when it is spent, we see clearly in those whose Heart-bag being wounded, the said Liquor hath run out: for in *Johannes Saviolus*, his Heart-bag being wounded with a Dagger, water issued at every Pulse of his Heart, out of the wound, yet was he happily cured by the Renowned *Veslingus*.

Whence this water should have its original, the opinions of learned men are different.

I. The first Opinion is of those, who will have it to be sent out of the Vessels of the Heart, seeing Blood-letting cures the Panting of the Heart proceeding from the Super abundance of this Liquor: And they conceive that this waterish Liquor is forced out by the fervent heat of the Heart, as in a stick of wood when it burns the sap runs out. Of kin to this is the Opinion of *Nicolas Massa*, which will have it to proceed from the strainings of the blood, which come from the Liver to the Ear of the Heart. And *Hofman* is much of his mind, who maintains that it is part of that wheyish moisture which ascends to the Heart with the blood; but because the motion thereof is perpetual, there would no small danger arise, from so large an Afflux of Humors. I let pass, how that the stronger persons, whose blood is moved most swiftly, have less quantity of this Water then those that are weaker.

II. Others, and among them *Hippocrates* seems to make one, will have it to proceed from our drink, some portion whereof they conceive peirces like Dew out of the *Asperia Arteria*, into the *Arteria Venosa*.

III. Some conceive it proceeds from a Warry matter in the Seed, as the inbred Air of the Ears, is thought to proceed from a windy matter in the said seed.

IV. Of kin hereunto is the opinion of *Jasolinus*, who will have it to be a select, most perfect and Elaborate portion of the serous Humor, sent thither by Nature it self, haply in the first formation of the Child, through the Veins and Arteries, besides another part of the drink, of which *Hippocrates* speaks, and he has experiments touching the same.

V. Some say it proceeds from the wary Excrements of the third digestion.

VI. Others from the spittle, slipping out of the Kernels of the Tongue into the Wezand, and from thence into the Arteries and Heart.

VII. Others, from the fat of the Heart, by agitation turned into water.

VIII. Others from the thicker part of the Air which we draw in, being changed into water.

IX. And lastly, some think (which I conceive to be most likely) that it proceeds from moist Vapors and Exhalations, forced out of the Humors of the Heart by the motion and Heat thereof, and thrust forth into the Heart-bag and there congealed into water, in regard of the compactness of the said Heart-bag.

Its Use is, I. To moisten and cool the Heart, and to facilitate the motion thereof. And therefore those in whom it is consumed, have their Hearts roasted: As it happened to *Casimire* the *Marque's*

Whence the liquor in the Heart-bag proceeds?

The first Opinion.

Marques of Brandenburg: Aud to that young man of *Rome*, mentioned by *Panarolus*. *Hofmannus* being of a contrary mind, will needs have it to be as a Spur and Incitement of Heat; as *Smiths* are wont to dip their wisps of Straw in Water that they may burn the longer: And as Wood is sprinkled with Water to make it burn more lustily. But those bundles of Straw are preserved by the water, because their substance being made more moist and Tenacious, is not so soon consumed. But the heat of the Heart is preserved by its radical moisture, and by the blood continually flowing in, nor doth it need any Incitement from the Water, for if so, then the Heart would be more hot and lusty in old persons, who have most water in their Heart-bags, II. It serves to make fat by congelation. III. That the Heart by swimming therein, may be less ponderous, and may not strike against any part.

An *HUMOR* likewise is commonly found in the Cavity of the Chest, resembling blood and water mingled together, wherewith the parts of the Chest are smeared, that they may not be overheated nor overdried. Hence the side of our Saviour being opened, blood and water flowed out, which by the sudden flux, and mixture of blood and the Authorities of the Ancients, I have at large proved, in my Dispute of the side of Christ, against *Laurentius*, *Arias Montanus*, *Bertinus*, *Nancelius*, *Poza*, *Tremellius*, *Beza*, *Tirinus*, *Grotius* and others, who would have it to proceed from his Pericardium or Heart-bag, also against *Collius*, *Tarnovius*, *Brentius*, *Laurenbergius* among the late writers, and *Cyprianus*, *Prudentius*, *Brigitta*, *Vida*, *Samazarus*, *Vigersus*, &c. who would fetch it from the Vessels of the Heart being wounded. Now the Objection of *P. Laurenbergius* is not worth a button, who saies there was not enough of the said Liquor in the Cavity of the Chest; because 1. The natural quantity might suffice, seeing the Evangelists do not record that it come away in a great quantity. 2. It might be augmented in that last conflict for life, notwithstanding the great perfection of his Body, which being for our Redemption made liable to temporary passions, underwent death it self. 3. I have at *Padua* sometimes observed so great a quantity of Water in this part, that it hung down like a great purse, the Midriff being depressed by its weight. *Jasolinus* in wound of the Chest (the inner parts being unhurt) did sometimes collect every day five measures of water called *Hemina*, for thirty daies together, which the Membranes being inflamed, was dried up and diminished, but when the Inflammation was cured, it returned in its former Quantity.

In a Boy at *Paris*, who died of the small pox, I being present, store of water was found in this part, but of a green colour, of which else-where.

Chap. VI. Of the Heart in General.

THE Heart is called in Latine *cor à currendo* from running, because of its motion; some peradventure will derive it from the Greek name *Kē* which they derive from *cto* which signifies to burn: the Greeks term it *cardia*, we the Heart, quasi *hierōn* a sacred thing. It is the principall part of a living Creature, which none is found to want according to *Aristotle*, and by the hurting whereof the Creature does for the most part immediately die, because it is the fountain of Life, and labors the vital Spirit, which having

made, it distributes, by the Arteries arising from it self, into the whole Body, Yet may you find examples in *Schenkius* of those that have had no Hearts. See also *Gellius* book the 16. Chap. 15. *Galen* relates that beasts sacrificed have lowed at the Altar, after their Hearts were taken out; and the Lord *Verulam* tells of a man who spake three or four words of a prayer, when his Heart was pluckt out of his Body, and in the hand of the Executioner. *Plinie* tells us the entrails were twice found without any Heart, when *Cæsar* sacrificed, and *Julius Obsequens* saies the same. The Lives of such persons were maintained, by the remainders of arterial Blood. And *Spigelius* suspects that among the *Bowells*, the Heart was rather hid, and unfound then wanting, who saw so much fat in an *Ostrich*, that a man might easily have bin deceived, so as to think the Fowl had no Heart. Peradventure those Hearts of the sacrifices were stole away by the Devil.

A Live-wight dies not with every hurt of the Heart. For the Heart undergoes all kind of diseases. 1. *Putrefaction*, witness *Galen*, in a pestilential and a putrid Fever. 2. The *Consumption* according to *Plinie*, to be dried like a roasted warden, according to *Jordanus*, to be wholly consumed by immoderate Heat, as *Tilesius* 2. verr's. 3. *Inflammation*, in which Case it cannot live a natural day, as *Saxenius* found by experience in a certain Reader. 4. *Filthy hollow Ulcers* have bin found therein by *Fernelius*, *Trincavellius*, *Reverius*. 5. Divers kinds of Tumors, *Columbus* saw an hard Tumor in the left ventricle of a Cardinal, as big as an Egg. *Benevonus* saw a swelling of black flesh. *Massa*, *Hollerius*, *Baibinus*, and *Joubertus*, have other like Stories. I lately found in the Parenchyma of an Oxes Heart on the left side a swelling as big as a Pigeons Egg, in a double Coat, full of Whey and Flegm.

On the out side *Gesner* saw an Excrecence of Flesh in the Basis the quantity of an ounce and six drams *Bavins* makes mention of the Membrane eaten and fretted away round about.

Also Histories shew that it will bear wounds for a season. *Parvus* tells of one wounded in the Heart who ran two hundred paces. *Jacotius* tells of an Hart that carried an old arrow fixed in its Heart, which is confirmed by *Thomas à Vega* and *Alexandrius*. *Galen* saw an Hare wounded in the Heart, run a darts cast after the wound received. Of a Student at *Ingolstadt*, *Sennertus* and *Johnstonus* tells us, who had both the ventricles of his Heart pierced through with a weapon, and *Nicholas Mullerus* of a Souldier who lived fifteen daies after he had received a wound in his Heart, of which he hung up a Table at *Greeningen*. He recounts many like examples seen by himself, and *Tulpius* tells us of one that lived two daies, being wounded in the right ventricle. *Glandorp* tells us after *Sanctorius*, that the Heart of a Rabbitt was pierced with a sharp Instrument, and yet it lived many months after.

We must therefore note 1. That the Heart can endure Diseases, but because it lies far from the way of medicines, it cannot hold out so well as other parts.

2. That, as *Galen* tells us, if the wounds do pierce into the belly thereof, the party or Creature wounded dies, of necessity, but if they be in the Substance thereof, it may live a day and a night, but then Inflammation arising death follows.

3 That the right Ventricle does more easily bear an hurt, because upon the left depends the life of the whole Body.

4. Both Ventricles may endure a small time after they are hurt, if the Vessels that continue the motion of the blood, be undamnified. The

The Heart is one in Number. Theophrastus writes, that in *Papilagonia* Partridges have two Hearts, an example whereof *Galen* relates in a man, in his anatomical administrations.

*Why the Heart
is in the middle
of the Body.*

It is situate in the middle of the body, not considering the legs, as it is in brutes; in which the Heart is in the middle, for moveableness and Securities sake, and in the middle of the Chest likewise, where it is on all sides compassed with the Lungs. Now the Heart in respect of its basis, is exactly in the middle, that nourishing blood and spirit might more commodiously be distributed into the whole body.

Howbeit the Motion thereof is more discernable in the left side.

*A vulgar Error
that the Heart is
in the left side.*

I Because in its left Ventricle the vital spirit is contained, and from thence arises the *Arteria magna*, hence the common people imagin that a Mans Heart resides in his left Side.

but Practitioners applie Cordials to the left side.

*Why the point of
the Heart inclines
to the left side.*

2 Because the point of the Heart inclines towards the left side, under the left nipple, that it may give way to the Diaphragma: now to the right hand it could not decline, by reason of the Vena cava, which ascends there through the middle of the Chest. Sometimes the upper part of the Heart inclines to the left side, and such persons are left handed if we beleive *Massa*, those whose Heart is exactly in the middle, use both hands alike.

*Who have the
greatest Hearts.*

As to its Magnitude. In a man proportionably the Heart is greater then in other Creatures, as also the brain and Liver. According to the common Course of Nature, it equals six fingers breadths in length, and four in breadth. Otherwise, the greatness of the Heart differs according to the Difference of the Age and Temperament. For persons cold of Constitution, and fearful have great Hearts, but such as are more hot and confident, have little Hearts: Of which see *Demetrius*. Hence *Aristotle* saies of tearfull Creatures, as the Hare, Deer, Moule, Hyena, Afs, Weazel, &c. that they have a great Heart, considering the proportion of their bodies. The Philosophers of *Aegypt*, in ancient times, as appears by *Herodorus* in his *Euterpe*, have dreamed these things of the greatness of the Heart. That the Heart of such Persons, as are not waisted by any violent disease, does every year grow two drams heavier, till they become fifty years old, so that a man of fifty years Age, his Heart weighs an hundred drams: but from the fiftyeth year to the hundredth, by a retrograde or back motion, it loosens every year two drams, till it vanish away, and the party die.

Its Figure is conick, because it ends in a point. Its upper part by reason of the full vessels therein, is broad and round, although not exactly, and is called the Root and Head, and Basis of the Heart: the lower part being sharper is called *conus*, *micro*, *vertex*, *cuspis* and *apex Cordis*: the cone, point, top of the Heart. *Hippocrates* calls it the end and taile. On the fore side the Heart is more bossie, on the hinder side more flat. In the contractions the whole Heart is longer as some hold, but broader and more drawn together according to others: in its Dilatations or Widenings it is greatest, and of a globous figure, of which I shall speak more exactly hereafter.

Its Connexion is to the Mediastinum and the Midriff by the Pericardium; but to other parts by its Vessels, they are joyned to the Basis, the point being free, and hanging dangling like a bell in the Steeple, that it may the more easily be drawn back to its Basis, or moved to the Sides.

Connexion.

Its Substance is first membranous, like a Bladder, in the Child in the Womb, afterward from the mothers blood there grows flesh or a solid, thick and compacted parenchyma.

1. That it might endure the perpetuity of the Motion: for a fence, and that it might more forcibly drive the blood to places far distant in the whole Body.

*Why the Sub-
stance of the
Heart is so
thick.*

2 Least the subtile and lightfull Spirits contained even in the moveable blood should exhale together with the inbred heart.

In the right side the wall is less thick, because it sends blood only to the Lungs, which have their venal blood not so subtile. The strength of the left side is greater, by reason of stronger motion to drive on the blood, to supply the necessity of the whole body. In the point, the flesh is thicker and harder not so much because it ought not to be moved, as *Riolanus* conceives, as because it is free, contracting the whole Heart in a brief manner, and destitute of Vessels and Ears. In its Basis, it is not so much softer as thinner, whose Vessels and Ears do recompence what it wants of firmness. Now this flesh hath all kinds of Fibres, so mingled one with another, and so compact, that they cannot be easily discerned; partly for strength, partly for motion. For all these Fibres being stretched in the Systole of the Heart they draw together the Ventricles and the inner sides, to help the Protrusion or thrusting forward of the blood.

This substance is cloathed with a Coat | Its Coat.
hardly separable, for the greater firmness, to which it grows in respect of the matter, not of the efficient Cause.

There is Fat about the Pasis of the Heart but hardly about the Cone or sharpe End thereof, because it is moistened by the liquor of the Heart-bag. 1. To anoint the Veins about the Heart. 2. And to moisten the Heart, that it may not be dried by motion. 3. To heat the water in the Heart-bag, as the fat of the Kidneys doth, according to the conjecture of *John Daniel Horstius*. Sometimes it is quite hid with the said fat, which *Spegius*, *Riolanus*, *Jessenius* observed in a prince of *Lunaburg*, so that the by-standers are apt to be deluded and think there is no Heart.

It was nevertheless rightly said by *Aristotle*, *Galen* and *Avicenna*. that fat called *Pimelo* could not grow about any hot part, as the Heart, the Liver;

*Whether Fat
is found about
the Heart?*

the Arteries, the Veins, &c. For this kind of Fat is easily melted by heat; but in the mean while, to steat *Adeps* or Tallow, which differs much from *Pimelo* or Greasie fat, in substance, consistency and place, as I have demonstrated in my *Vindicie Anatomice* from *Pollux*, *Suidas*, *Erotianus* and others, may grow about such parts, because it is not easily melted. Which makes a sputtering when it is put to the flame of a Candle, because of a watry substance mingled therewith, according to the Observation of *Jasolinus*, which hinders it from suddain congealing: so that it is no wonder that it is not melted by the heat of the Heart. Now this same Tallow is bred about the Heart, either

Ff

because

because the Heart being of a very hard substance is nourished with thick blood, of which suet is bred; or because Excrementitious dregs are bred of the Nutrient of the Heart; or because the blood is much stirred, as by the great Agitation of Milk, better is extracted, which is the opinion of *Achillius*.

As for *Vessels*. The Heart hath a Vein which is termed *Coronaria* the Crown-vein, because it incircles the Heart, and is sometimes double. It arises from the Cava, without the right

Ventricle, about whose Basis it Expatiates in a large tract from the right Ear, and with a wide Channel it compasses about externally to the left Ear, which it doth not enter, but turns aside into the *Parenchyma* of the Heart. Hence it spreads its branches downwards through the surface of the Heart, but the greatest store through the left side thereof, because the flesh is there thicker. A small valve is fastned in its original, which grants entrance to the blood into the right Ventricle, but will not suffer it to go out.

The FIGURE Explained.

The III. TABLE.

This TABLE shews
the Situation of the
Heart in the Body
and the going out of
certain Vessels there-
from.

- A. The Heart in its natural Situation enclosed in the Heart-bag.
- BB. The Lungs.
- CC. The Nervous part of the Midriff.
- DDD. The fleshy portion thereof.
- E. A portion of the Vena Cava above the Heart, going upwards.
- F. Part of the said Vein piercing the Midriff.
- G. The great Artery arising out of the Heart.
- HH. Its branches to med Carotides, the *Dromae* Arteries.
- I. The point of the Heart, inclining to the left side of the Body.
- KK. The Nerves of the six Conjugation, from which the recurrent Nerves do spring, which distribute five branches to the Heart-bag & the Heart.
- L. The left Ear of the Heart.
- M. The right Ear.
- N. The Vessels of the Heart-bag.
- O. The Cartilago Scuriformis, Shield-fashioned Gristle.
- P. The first pair of the Muscles of the Larynx in their proper place.
- Q. The Situation of Os Hyoides.
- R. The Aspera Arteria or *Wozand*.
- S. The Axillary Artery, about the Original whereof, the Right-hand Recurrent Nerve begins.



As for its Use. Some have perswaded themselves, that it serves to nourish the external part, because it is lesser then ordinary, creeps about the external surface only, and the Heart is nourished with Arterial blood. Others will have it to nourish the whole Heart. *Licetus* assigns its Office to strain the blood to the left Ventricle of the Heart, which I wonder at, Because 1. It is exceeding small. 2. It creeps about

the External parts. 3. It arises externally from the Vena Cava, and not from the right Ventricle of the Heart. *Borallus* seems to have acknowledged the same way, whose opinion examined by *Walaus*. Others, as *Riolanus*, make it serve not so much for Nutrition, as to repair the fat; but, first it reaches farther then the fat. 2. No branches thereof are to be seen in the fat. 3. The fat may be generated from Vapors

Vapors of the Heart, without any Veins. The *true Use* of the *Coronary Vein* is, to bring back the blood of the other Veins, when it returns from nourishing the heart, into the right Ventricle again, which the Situation of the Valves doth hint unto us, and the unfitness of this blood to nourish the solid substance or *Parenchyma* of the heart.

It hath two *Coronary Arteries* from the great one, at the same place, in its original, before it passes out of the Pericardium, furnished with a Valve which prohibits the regress of the Blood. Through these, because they are moved and Pulse, blood is carryed to nourish the heart and Ears, and here is made a peculiar kind of *Circulation*, as *Harvey* teaches, out of the left Ventricle into the Arteries, out of them into the Coronary Veins, out of which it slides into the right Ventricle, being to be forced again through the Lungs into the left Ventricle.

Now some men perswade themselves, and especially *Hogelandius*, that the Blood which remains after Nutrition, doth not all pass back through the Veins, but that some particles thereof sweat through the *Parenchyma* into the Ventricles, and cause Fermentation in the Generation of Arterial blood. But 1. The Fermentation, if there be any, may be made by the reliques contained in the Cavities. 2. The coronary Vessels, do not reach unto the Ventricles. 3. 'Tis hard when the body is in health, for the blood to sweat through so hard and compact a flesh, unless the blood be very wheyish, and the body of a thin Texture. 4. Why doth not the blood sweat through the Skin, which in some parts is very thin? 5. No particle remains in the flesh, save what is ordained for the nourishment thereof.

Nerves it hath likewise, obscure ones, from the first conjugation, inserted into three places: One being terminated into the heart it self: Another into its Ears; A third among its greater Vessels, to cause sense and not motion according to *Piccolhomineus*, because the Nerve being cut asunder the heart moves nevertheless. The heart hath not many Nerves, but a great Contexture of Fibres like to the Nerves, which *Aristotle* perhaps reckoning for Nerves, said the heart was the Original of the Nerves. But that may be *Materially* true, not formally. Yet I have seen in the heart of a Sow, the branches of the Nerves with intangled twigs towards the Cone or Point, carryed from the Septum to the Wall of the Belly.

An Error of Fallopius. Yet that is false which *Fallopius* tells us, that a great Squadron of Nerves is spread up and down the Basis of the heart, resembling a Net: For the motion of the heart, is no Animal motion, but a natural motion, because the heart is no Muscle: For the heart is moved without our will, and it beats in the Child in the Womb, before the Child hath received the Animal faculty. And *Galen* did rightly deny that the heart was a Muscle.

Whether the Heart be a Muscle? 1. Because it hath all kind of Fibres. 2. Because a Muscle is the Instrument of voluntary motion. But if any one shall

say the heart is a Muscle subservient to natural motion, I shall oppose such an improper manner of speaking: And so that of *Hippocrates* may be true, that the heart is a muscle. For he defines a Muscle to be flesh made up into an Orbicular shape. Others conceive that being long boyled it resembles a Muscle, and that then it is not one, but divers Muscles, by reason of divers motions contracted into themselves.

Others grant it to be a Muscle of a nature by it self, as the Midriff, which is perpetually moved. *Waleus* most rightly of all others calls it not a Muscle, but saies it is contracted in its motion like a Muscle, by Fibres interwoven in the flesh, and especially in the Ventricles, like the temporal Muscle in such as chew their meat.

The Temperament of the heart in respect of active Qualities is hot, yea the hottest of all the parts of the Body. Howbeit with a gentle and light-ful heat, not scorching and burning, if it be rightly disposed. And therefore tis no wonder, that in live dissections, sometimes we feel so little heat in the heart with our Finger, especially when our Skin is thick, we hold it but a little while, and the external Air is not rightly prepared before hand. It communicates the same heat to other parts, and renders the Arterial blood fit to nourish, which heat being asswaged in the Veins by reason of the long journey, it must of necessity run back again to the heart, that it may be refurnished and restored with the same heat. But vain is the opinion of *Averroes*, that the heart is cold, because of the cold parts which it contains, viz. its Vessels and Valves: Unless haply he ment the heart void of Spirit, as many will have it.

Those whose heart is hotter then ordinary have their Breast rough with hair, and the parts near their Hypochondria; and those men are angrily inclin'd, and daring.

Seldom is the heat of the heart so great, as that it self should thereby become rough with hair, such as *Pliny* and *Valerius Maximus* tell us was found in *Aristomenes* a Micenian; and in *Hermogenes* a Grecian, *Calius Rodiginus* relates: and *Beneventus*, *Lusitanus* and *Murelus* avouch that they saw such hairy heart in certain Famous Theives. Now such Men are audacious in the highest degree, extream hot and crafty, and for the most part wicked. *Riolanus* tells us, that the matter of these haire, is the thick settlings of that wheyish humor which is in the Heart-bag. But I am more apt to beleive, that it is the plenty of Fuliginous Excrements springing from an hot heart.

As to the passive Qualities, the Heart is moist, viz. more moist then the Skin, but drier then the Muscles, because harder: for the parts of the bodie, look how much softer they are then the Skin, by so much are they moister then it. It is a most rare Case for a mans Heart to be so solid, dense and compact, as that it will not burn, such as was the Heart of *Germanicus* the son of *Drusus*; or cartilaginous, such as *Riolanus* observed in a wicked fellow.

The primary Use of the Heart.

1. According to *Harvey*, *Baccius*, and other of his followers, is no other then to be the Instrument of the Soul, to force and urge the venal blood received from the Ears into the Arteries, by whose assistance it dispenses Nutrimment to the whole body, and is rather joyned as an Assistant to the Ears, that being of greater force, it may supply the defect of the Ears.

But this is a secondary use of the Heart. For 1. Nutrimment was to be prepar'd & filled with vital heat, which it has not else where save from the heart. 2. Nature might have provided for this passage of the blood, by some other member not so laboriously framed. 3. The necessity of the Heart would not be so great as it is. 4. It is a signe that some farther thing is performed

The Error of Averroes.

An Hairy Breast what it signifies?

An Hairy Heart what it signifies?

the Heart, in that venal blood does not nourish, before it enters the Heart.

Now the primary action of the Heart is to be.

II. The *Fountain of Heat*, whence it is spread into the whole body, whereby the parts are animated and sustained. Swallowing teaches so much and other defects of the Heart, in which the heat of the Heart being intercepted, the Members of the Body begin to flag and being destitute of heat, become stupid. And therefore cordials do good in such cases, which stir up the languishing and nummed heat of the Heart. Also the Dissection of living Creatures does shew, that the Heart is hot, yea that the heart of a Creature being taken out and newly dead, a warm finger, or some other warm thing being laid upon it, is seen to come to its self again and to stir, which the Lord *Bacon Constantine, Harvey*, and others have observed in a Dove, an Eele, a Salmon, and a Man.

It is therefore the Fountain of Heat, both in respect of its *Substance* and of the *Blood* contained in it. I joyn both together. For the Heat springs not from the blood alone, as *Harvey* would have it, for the Heart in an Egg, and a Child in the Womb, before it is perfect and hollowed with ventricles, is hot and moves, and the same heat remains in Hearts taken out of the Body and cut up. The blood which flows thither from the Coronary Vessels, flows thither for Nutritions sake and to preserve the Heart. Nor are the rest of the sanguine parts, therefore judged to be hotter than other parts because they more abound with any heat, but because they have Arteries full of arterial blood, and depend upon the influence of the heart, wherewith the blood is heated. So that unless all the blood did pass through the heart, the parts would never grow hot, and the further the blood goes from the heart, by so much the slower in its motion, and the colder it grows. That the coldness of the heart makes the parts of the Bodie cold, though full of blood, the slowness of the Pulse is a sign.

Nor do the Blood and Heart grow hot only from the motion of the Heart, as the followers of *Des Cartes* will have it, for 1. they grant that the fiery atoms or indivisible particles of fire, are excited and put into action by motion, though they are only brought into play, but not produced by the said motion. 2. Many things are moved without waxing hot, as water, unless they have an inbred principle of heat. 3. Before motion there was heat proceeding from the seminary original, which is afterwards preserved by continual motion.

III. Not so much to make as to perfect the Blood.

Whether the Heart perfects the venal, or that which is contained in the Veins. For they are out who attribute too much to the heart, as if the heart alone did make blood of the Chylus, they also are mistaken, who maintain that the heart contributes nothing to blood-making. I goe in a middle way. The Liver challenges the first making of the blood of the Chylus, as I have formerly demonstrated, which because it is not there perfected, being to thick and unfit to nourish, it is necessary that it should receive its perfection from other parts. No part is fit for this work save the heart, which is one of the first parts generated in the Womb, and through which in a grown person all the blood in the body has its passage. That the Lungs and heart-ears should perform their Office, no man will believe.

The heart perfects two sorts of Blood, that of the Liver and that of the Veins. That of the Liver is twofold, the one of the Vena portæ, the other a cruder sort newly made of Chyle. The Vein blood is likewise twofold,

one of the descendent trunk of vena cava, and the other of the ascendent trunk of the said vein. It receives the Liver blood through the Cava, to which another joyns it self out of the lower and upper Trunk, which remaining over and above after the parts are nourished, by its long journey is become pauld and sluggish, and has lost its heat, which is necessary for pullation and nutrition.

This perfection which the Blood receives from the heart, is hereby confirmed, in that the blood when it comes out of the left Ventricle, has not altogether the same Consistence nor Colour, which it had when it entered the right Ventricle. The diversity consists in Heat and plenty of Spirits, wherewith it is furnished when it goes out of the heart, and which it wants when it enters thereinto; and in Effect or Operation, for that which goes out is fit to nourish, but that which enters in is most unfit, Vital Spirits are added by the inbred faculty of the heart, and the sooty vapors are taken away by that most short Concoction, being evacuated by the Lungs and Pericardium or heart-bag.

For what parts does the heart perfect and renew the blood.

The ancients did beleive that the Heart made blood only to nourish the Lungs. But the Vessels of the lungs are greater then is requisite only for their Nutrition, and there is continually more blood forced thither by the pulsation of the right Ventricle, then could any waies be useful for the Lungs, unless they were to be nourished with as much blood as is sufficient for the whole Bodie. And that all is not consumed upon the substance of the Lungs, the blood which returns is a witness, which runs in great plenty at every pulsation, to the left Ventricle, through the Arteria venosa, which in live anatomies, being tied, is seen to swell betwixt the ligature and the Lungs. For there is no way for it to return into the right Ventricle, the passage being stopped by the close shutting of the mitre-fashioned Valves.

The right Ventricle therefore is busied about blood which is to be sent to nourish the Lungs; the left doth perfect the blood which flows back from the Lungs, being there imprægnated with air, for the Nutrition of the whole Bodie. For the arterial blood alone is that which nourishes, because it is only fit for nutrition, and it alone is forced through the Arteries into the utmost parts of the Bodie.

To perfect this blood many things concur. 1. Heat, which is very dull and lasie, as well in the crude blood of the Liver, as in the returning blood of the whole Body. 2. Vital Spirit which by the confession of all men, ought to be joyned therewith. 3. Light the companion of the Spirits, by which the blood receives a more illustrious color, is moved and made fit for Nutrition. 4. A certain light and momentary Concoction, sweetening the cruder parts, attenuating the whole substance, and drawing forth the latent flame. 5. The whole Fabrick of the heart, internal and external, and the Vessels both receiving and expelling. 6. The separation of Excrements, though the receptacles of the said Excrements are not very manifest. The sooty Vapors of the right Ventricle do evaporate through the Vena Arteriosa. The Warty Vapors of both the Ventricles, are congealed into the water of the Heart-bag, and are spent into the substance of the Hairs under the Arms. The remaining Excrements continue mixed with the Blood, and are carried into the Arteries, and the wheyish parts are purged by the emulgent Arteries into the Kidneys,

Kidneys, and by sweats into the habit of the Body, the thicker parts by the Hemorrhoidal Arteries and the Ramus Mesentericus. Some parts return with the blood through the Veins into the Heart, that by several repeated courses there, they may be at last mastered and overcome.

In which Ventricle the Blood is perfected.

Whether or no is the Blood equally perfected in the right and left Ventricle?

Although the heat of both the Ventricles doth seem to be equal, because in Mankind they are both made of spirituous feed, and as much is afforded to the right Ventricle by the Liver-blood, and the returning blood of the Veins, as to the left by the Lungs; moreover in Live Anatomies we can hardly perceive that the one is hotter than the other.

Yet that in the left the blood receives greater perfection, these signs and tokens do persuade me; because

1. It receives the Blood in some measure prepared from the Lungs.
2. It ought to perfect it for the whole Body, whereas the right perfects it only for the Lungs.
3. It hath thicker Walls, more compacted fleshy Pillars, wherewith the heart is both more easily preserved and reverberated, and the blood more strongly driven.
4. The blood is therein more frequently clotted by heat, and Cartilaginous and boney substances appearing being dried by heat.
5. When the left Ventricle is hurt, there is greater danger of death, than when the right is hurt.
6. Many Live-wights want the right Ventricle.
7. In dying persons it is sooner dead and void of motion than the right.
8. The Cavity thereof is more narrow, and therefore it doth more easily preserve and perfect that which is contained therein.

We cannot exactly define the place. It is the whole Cavity, endued with the virtue of the Parenchyma, because the blood fills the whole in the Diastole, and the inbred spirit, is every where diffused. Nor is there any token, of any stay which the whole blood makes in one place more than another, nor of any peculiar virtue of any particle.

The Time. It is perfected in a Moment, because

1. It is forthwith received and expelled, and makes no tarriance.
2. From its abidance there, the blood would not be perfected but become adust.
3. The flame on the Candle snuf, lights another Candle in the twinkling of an Eye.
4. The Arterial Blood doth continually run to the extremities of the Body, and therefore it ought to be continually and suddenly perfected in the Heart.

IV. A fourth use of the Heart is perpetually to move. 1. That it might preserve the Blood and all parts of the Body from putrefaction. 2. That it may help the heat and Elaboration of the Blood. 3. That it might kindle and stir up the vital Light. 4. That it might send fitting nourishment to all parts.

This motion of the Heart is termed *Pulsus* the PULSE, which is continual without ceasing, raised by the influent Blood, and the Pulsifick or Pulsative faculty, there resident.

Its Parts. It consists of a *Systole*, *Diastole*, and *Peri-systole*. Which must be diligently considered by all their causes, according as Occasion

of living Bodies and reason shall Dictate.

Systole, being the proper and natural motion of the heart, is a contraction and drawing of the heart into a narrow compass, that the blood may by that means be forced out of the right Ventricle through the Vena Arterialis, into the Lungs, and out of the left Ventricle through the Aorta into the whole Body.

Diastole, being an accidental motion, is the widening of the heart, that Blood may be drawn in through the Vena Cava into the right Ventricle, and through the Arteria venosa into the left.

Peri-systole is a certain rest and stop going between both motions, when the Blood is about to enter into or go out of the Ventricles, to smail in healthy persons that it cannot be discerned, being very manifest in such as are at the point of death. It is only one between the *Systole* and *Diastole*, or between the *Diastole* and *Systole*. This is the natural state of the heart.

Besides these motions two others are Observed.

1. A certain Undation or waving towards one side according to the carriage of the right Ventricle, as if it did gently wreath it self, as we see in an horse when he is drinking; of which *Harvey* speaks.
2. A trembling motion of the Heart, when it is cut in sunder. The former depends upon the Situation of the right Ventricle: The latter is preternatural to the heart, not arising from other particles or smail Bodies, sent in by the Coronaria, which is then cut in sunder, but from the remainders of the vital Spirits.

We are taught by the testimony of *The Heart takes our Eyes*, that in every *Diastole* blood is plentifully received in, and in every *Systole* plentyfully expelled, both into the Vena Arteriosa and the Aorta. This appears I say to our Eye-sight.

1. By Ligatures or bindings in live Anatomies. If the *Cava* and the *Aorta* with the Vessels of the Lungs shall be bound or pressed down with the Finger or any other Instrument on either side; we shall manifestly perceive that the part of the *Cava* which is inserted into the Heart is made empty; that in the *Diastole* of the Ear, it is filled, and thereby the Heart; and that the other part of the Ascendent and Descendent Vein, on this side the Ligature, doth swell. In like manner, the *Arteria Venosa* being tied near the heart, by the *Diastole* of the left Ear, it is made void and empty on this side the Ligature where it looks towards the heart, but towards the Lungs it arises and swells. The Arterial Vessels of the heart, do shew themselves in a contrary fashion: For the *Vena Arteriosa* being tied, it swells towards the heart, because it is filled by the *Systole* of the right Ventricle; the *Arteria Magna* being bound, swells between the heart and the Ligature, being filled by the *Systole* of the left Ventricle.

2. Besides the Ligatures, we may gather as much from the vessels being opened or wounded. The *Vena Arteriosa* and the *Aorta Arteria* being opned by a *Langet*, at every *Systole* or Elevation and Contraction of the heart, it pours forth plenty of blood, as long as the heart continues strong, for when it languishes, it intermits some Pulses, before it voids any Blood. Now we observe no such thing, when the *Cava* or *Arteria Venosa*, are opened between the heart and the Ligature.

3. The point of a living Heart being cut off, or the heart being cut asunder through the middle, in every Contraction blood issues out, as long as the heart remains vigorous, which by the Information

The FIGURES Explained.

This TABLE doth in some measure express the Systole of the Heart in a Living-Creature, and the Circulation of the Blood.

FIG. I.

- AA. The Lungs drawn back.
B. The Aorta Artery bound, and swelling towards the Heart.
C. An Orifice made in the swollen part.
D. The Vena Arteriosa tied, in like manner swelling towards the Heart, growing yellow where it looks towards the Lungs.
e e. The Ears on both sides.
FF. The Fore-side of the Heart, being in the Systole somewhat hard, and bent, and with its sides extended, its point being drawn back to the Basis or broad End.
gg. The Coronary Vessels.

FIG. II.

Shews the form of the Heart in its Diastole, and the motion of Humors in its vessels.

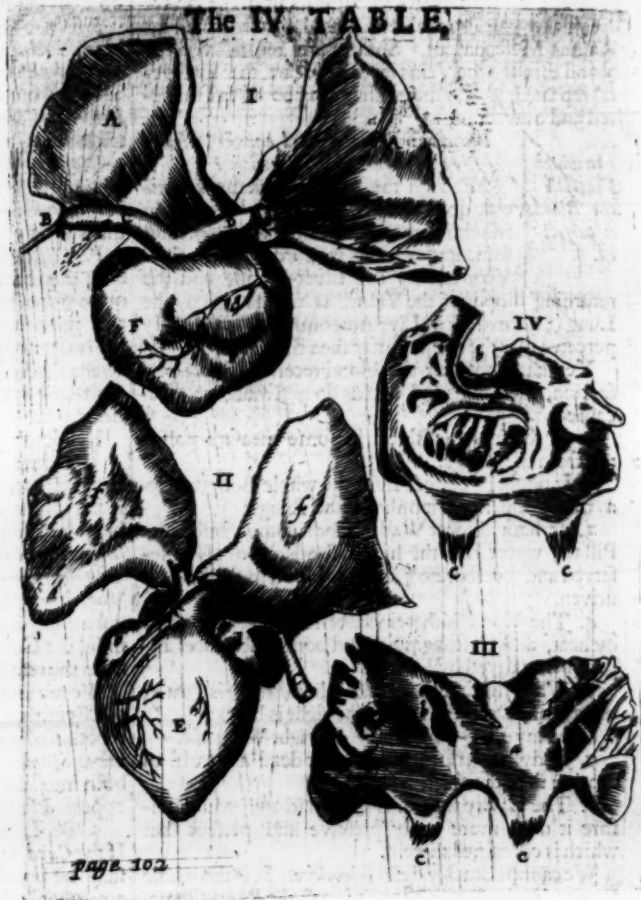
- a a. The Arteria Venosa without binding, being full towards the Lungs, empty towards the Heart.
b. The left Ear, which receives blood from the Arteria Venosa.
C. The Vena Cava tied, empty towards the Heart, full towards the Liver.
d. The right Ear swollen or heaving.
E. The hinder-side of the Heart, as it is in its Diastole, flagging.
ff. The hinder part of the Lungs, which are bunching or Boffie.

FIG. III. and IV.

Represents the Inside of the Earlets or little Ears of the heart. The third Figure Represents the left Earlet; The fourth, shews the Right

- aaa. 3. 4. The Plane Membrane of the Earlet.

The IV. TABLE



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- b. 3. The Orifice of Arteria venosa. 4. The Orifice of Vena Cava.
cccc. 3. The three-pointed Valves with seven Fibres, in 4. the same with five only.
ddd. The larger fleshy Pillars.
eeee. The lesser fleshy Pillars, Intertwoven one within another with wonderful artifice.
fff. Many-fold Cavities formed between the Pillars.

of Harvey, I have often seen in the Dissections of *Waleu*.

4. The swelling of the Heart and the Flagging thereof, being Palpable and visible to the external sense, do sufficiently demonstrate, when it is made strait in the Systole, that of necessity somewhat must be squeezed out as it were forcibly, and that when it is widened in the Diastole, it must needs be filled with humors.

5. The Ventricles in the Diastole appear greater, and in the Systole lesser.

6. From the largeness of the Vessels of the Heart: the Vena Cava and Arteria Venosa, do open into the heart with wider mouths, then to suffer only a small quantity of blood to enter. Also the Arterial vein and the Aorta are larger, then to send forth nothing, or only Spirits.

The Quantity of Blood which fills the Heart in the Diastole, and which goes out by the Systole at every pulsation cannot be exactly measured, because it varies according to the different state of the heart,

The Quantity of blood in the Heart.

heart, and the temper of Animals, their Age, Sex, course of Diet and Life, &c. It is apparent to our Eyes in live Anatomies, that much is received and expelled. But it moves not in and out in so great quantities in persons that are well in health, when the Heart is more quiet and hath the command of it self. The Antients supposed that a drop or two was enough at a time, and that the blood did freely pass and repass the same way. But one drop of blood unaltered, is not able to fill the heart, nor doth provoke it to pulsation, nor to speak how the foresaid experiments do shew the plenty that passes to and fro. Now the Valves do hinder the free passage and repassage of the blood by the same waies, of which the three pointed ones or *Tricuspides* so called, do hinder the blood which enters the heart from passing back the same way, and the Mitre-shap'd Valves do hinder the blood which goes out of the heart from returning the same way.

Later Physicians, are divided in their opinions. Some suppose that a drop or two is either so rarified as to fill the heart, amongst whom is *Des Cartes*; or is turned into Spirit, as *Riolani's Primrose*, *Leibner* and others suppose, who measure it by grains, whom we shall answer when we come to the Causes: Others being Patrons and favourers of the circular motion of the blood, as *Harvey*, *Waleus*, *Conringius*, *Slegelius*, &c. do calculate the quantity, by ounces, drams and scruples.

To clear up this Question, three things are to be considered, 1. How much blood is contained in the Diastole of the heart. 2. How much is expelled or driven out of the heart, in its Systole; whether all that enters the Heart in its Diastole, is squirted out in the next Systole. 3. How many pulsations the heart makes in one hour; or how often the heart receives somewhat by its Diastole, and expels somewhat by its Systole, in the space of an hour.

1. In the heart being in its Diastole, *Harvey* hath found above two ounces of blood. Also *Plempius* found near upon two ounces of blood, in the left Ventricle of the heart of a man that was hanged. *Riolanus* will hardly allow half an ounce in the left Ventricle of one that was hanged, and saies there was more blood in the right Ventricle. *Hogeland* also will have half an ounce or a dram at least, to enter, at every opening of the Ear.

Now the quantity of all the blood contained in the body, doth seldom exceed twenty four pounds, or come short of fifteen.

2. In the Systole there is expelled either a fourth part, or a fifth, or a sixth, or at least an eighth, or all together that is contained in the heart.

Harvey supposes half an ounce in a man, or three drams, or one dram, in a Sheep and a Dog he saies a scruple. And he proves the same by that suddain effusion of all the blood, if the very least Artery be cut, and because in the space of one half hour, all the blood may be passed through the heart, he certainly concludes, that in every Systole of the heart, much blood is expelled. *Conringius* approves of his Computation. *Waleus* admits of half an ounce, but he supposes only one scruple, as doth *Slegelius*. *Regius* has many times observed half an ounce, sometimes two or three drams, in the heart of a Dog dissected. *Hogeland* contents himself with a dram. I being more sparing suppose half a scruple, in the smallest proportion to the quantity which issues in such a heart. For there goes not but so much blood out of a free heart, as in one that is bound and forced, nor

there so much expelled in the following Systole, as was drawn in by the Diastole, some part sticks in the hollow pits of the heart, much stais in the Cavity formed by the production of the three pointed Valves and Distinct as it were from the Ventricle; finally, the heart cannot be so straitly contracted in the Systole, as to squeeze out every jot of the Blood therein contained. Therefore *Conringius* doth rightly suspect that abides there the space of one or two Pulses, till by little and little it raise it self, which I understand of the reliques and part of the Blood, not of the whole received by the foregoing Diastole.

3. *Primrose* numbred in one hour 700 pulsations of the Heart. *Riolanus* 2000. *Waleus* and *Regius* 3000. *Harvey*, 2000. in some 4000, 6000, 8000. *Cardan* 4000. *Plempius* 4450. *Slegelius* 4876. I have told upon mine own wrist about 4400. But the number varies according to the Age, Temperament, Diet &c. of every person. So many Systoles therefore and so many Diastoles there will be in one hour, as long as the Heart is vigorous, for a languishing heart has more Diastoles then Systoles.

From these three Præmisses I have calculated, how much blood may in an hour be squirted out of the Heart, by its sundry pulsations.

From 1 scruple 3000		101. 5 ounces.
1 scruple 4000		131. 10 oun. 5 dr. 1 scr.
1 scruple 4450	times	151. 5 oun. 3 dr. 1 scr.
half a scruple 4400	re-	71. 7 oun. 5 drs, 1 scr
1 dram 2000	peat-	20 l. 10 ounces.
2 drams 2000	ed, a-	41 l. 8 ounces.
half an ounce 2000	rife.	83 l. 4 ounces.
1 ounce 2000		166 l. 8 ounces.

Now supposing all the blood contained in a mans body to be fifteen pounds, if that be taken away which goeth into the Nutriment of the parts, the defect whereof is supplied by new blood bred in the Liver, it will follow,

1 That more blood passes through the Heart every hour, then can be afforded by the Concoction of the Liver and the Stomach.

2 That all the Blood in the Body passeth through the Heart, in the space of a quarter of an hour, or half an hour, or an hour, or an hour and an half, or two hours at the most. For I cannot agree to *Riolanus* his conceit, that the blood is circulated only once or twice in a day, because he builds upon a false supposition of drops, and that only half the blood is circulated.

3 That the parts to be nourished do not need so much blood for their nourishment.

4 Because neither the Vessels are broken, nor the Arterial blood can run back again because of the valves nor is elsewhere dissipated, of necessity it runs back through the Veins into the Heart, and the Circulation is performed, of which I shall speak more in my book of Veins and Arteries.

What the form of the Heart is in its Systole and Diastole, is known by three tokens. 1 By the Anatomy of living Creatures 2 By the Comodity and Convenience of motion and 3 By the carriage of the fibres and the situation of the parts.

In the Systole 1 The Point of the Heart draws up to the basis or broad end, and it becomes broader because it is busied in expelling the blood, the length being changed into breadth, because the basis is broad and is immoveable in respect of the point, which

The form of the Heart in the Systole.

which is tied to no Vessels. But according to the observation of *Waleus* in those living Creatures, whose *Aorta Arteria* does not proceed from the Basis, the broad end or basis of the Heart withdraws it self from the Point. *Riolanus* will have the Basis of the Heart always to draw towards the Cone or Point thereof, because the said Cone is harder then to be drawn or bended backwards. But else where, he denies that the Basis being strongly fastened to the vessels, can be drawn towards the Point. And therefore other, whom *he* and *Slegelins* do follow, conceive that it is extended long-waies, that its walls being contracted, it may expel the Blood. But then the Orifices of the Vessels being drawn downwards in the lengthening of the Heart, would be shut, and a contrary motion would happen; besides that living Anatomies do shew, that the heart becomes shorter in its Systole. Nor can it appear longer but shorter, if either the point draws to the Basis or the Basis to the point. Both forms serve for expulsion of the blood, for whether you press a bladder full of water longwaies or broadwaies, you will squeeze out the water as soon one way as another.

2. The inner walls are on each side, drawn up to themselves towards the Ribs, because they are contracted and strained, as we find by putting our Finger in: But the outer parts being swelled, seem to be made broader, by reason of the contraction of all the parts, blown up in the distension. It differs therefore from *Galens* Systole, which *Leichnerus* will have to be drawn likewise into it self, the Longitude of the Heart being changed into Latitude. For indeed and in truth the Diastole is, when the heart is made wider, either long-waies or broad-waies, to the intent that it may be filled, unless the inner parts be strained.

3. The foreside of the heart is lift up towards the Breast-bone, especially about the Basis. For the Broad end or Basis of the heart, smites the Breast where the Pulse is felt, because that part is raised, and nearest the Breast-bone; in the Systole the Heart is vigorated and mettlesome, not in the Diastole, and then the Arteries are dilated and filled, whereas the heart is emptied in the Systole, and at the same time the Pulse is felt, in the Wrist and the Breast, at one and the same time. But the Pulse is most of all discerned, in the left side of the Breast, because there is the Orifice of the Arteria Aorta.

4. The whole heart becomes every where tight and hard.

5. It is more contracted and straiter then within, and less in bulke, which we judge by our sight and feeling.

6. It appears white, especially in the more imperfect sort of Animals, by reason of the voidance of blood in its Systole.

In the *Perisystole*, when the heart is loose and soft, before the *Diastole* follows, and the heart is in its proper state.

1. The point withdraws it self from the Basis, and the Basis from the point in some persons.

2. The lateral parts internal and external do extend themselves towards the Ribs.

3. The foreside falls in, the hinder part is depressed, especially above at the Orifice of the Aorta, according to the accurate Observation of *Waleus*.

The other *Perisystole* which goes before the Systole, is hardly by any notes discernable from the *Diastole*.

In the *Diastole*, which *Backius* tells us begins in the middle way to Dilatation, and ends in the middle way to contraction.

The shape of the Heart in the Diastole.

1. The upper side is lifted up and swolne by blood flowing in on either hand by the Venal Vessels, the swelling proceeding by little & little to the point. But it doth not then smite the Breast, as *Laurentius* and *Rosellus* would have it, because the Arteries undergo the Systole, and the heart ceases from expulsion, for which cause it is not Vigorated.

2. It is more flagging and softer, because it suffers in its reception of blood.

3. The sides remain more lank and extended, and the Cavities remain wider, and therefore when a man puts his Finger into a living heart, he feels no constriction.

4. It is red, because of the thinness of the walls, and the Blood received in, which is Transparent.

5. The Cone departing from the Basis in the *Perisystole*, renders the heart more long, that it may be more capacious to receive the blood. That it is drawn back towards the Cone, as many write, our Eye-sight will not allow us to believe, nor can it or ought it so to be. It cannot because the Fibres are relaxed and not bent; nor ought it, because it must be enlarged to receive, which you may in vain expect, the Ventricles being strained and revelled. Nor do I assent to *Des Cartes* and *Regius* men of most subtle wits, that in the *Diastole* the point draws near to the Basis; in the Systole it departs therefrom; for they confound the *Perisystole* or quiet posture of the heart, in which the heart is soft, loose and void of blood, before the *Diastole* is performed, after the Systole is ended. Moreover, *Waleus* believes, that those men were deceived, who in a wounded living heart, pretend to have seen blood expelled in the *Diastole*; because they took that to be the Dilatation, which was indeed and in truth the contraction. The blood which goes out of the wound, goes out in the *Diastole*, not driven by the Pulse, but because the way lies open downwards, it gently slides out, drop by drop.

The Efficient Cause of the motion of the heart, is either immediate or remote. The Immediate is twofold, the Blood and the Pulsifick faculty.

The next Efficient Cause of the motion of the Heart.

Pulsifick or Pulsative faculty.
The Blood either remains in the same quantity as it flowed in, or it is changed in quantity by boiling, working and rarifying.

1. Pure blood and sincere, flowing in through the Vena Cava and Arteria Venosa, and remaining such, only becoming more perfect and vital, raises the heart into a Tumor like water in a Bladder or Skimbottle, which being for the greatest part distended, because the plenty of blood is burthenfome, it raises its self to expel the same, by gathering together its Fibres; and this motion happens to the heart in this case, as the motions of other Members, viz. the stomach, Guts, Bladder, Womb, which are extended by the reception of Chylus, Whey, Wine, Blood, &c. which being expelled they fall again; and like the Muscles, which are stretched being swoln with Animal Spirits. By this Blood the Heart is continually moved, as a Mill-wheel is by the perpetual falling down of the Water, which ceasing the Wheel stands still. There is plenty of blood enough to distend it, nor so much furnished from the Liver, as from the ascending and descending branches of the Cava, running

ning back from the remotest Veinules or smallest branches of the Veins, and it is continually forced along, with Celerity and Vehemency, according to the Demonstrations and Doctrine of *Harvey* and *Waleus*. I shall justify what I now say with only one experiment: If the Vessels which bring into the heart be tied and so stop'd, the Heart's motion ceases, and there remains nothing but a Wavering and a Palpitation: but the Ligature being loos'd, it recovers its motion.

Aristotle makes the Cause to be Blood which is not pure, nor in so great quantity as to be able of it self to distend the Heart, but boyling and working, which boyling of the blood many have followed, though explained after a different manner. *Caspar Cremoninus* makes the cause to be the resistency of the Heart, and the swelling thereof by reason of the Ebullition, which afterward falls, by reason of the inbred heavyness of the heart, as parts puff up with wind, do of their own accord settle when the wind is out, and the heaving of the Earth caused by repletion and blowing up of wind, settles again, by the peculiar heavyness of the Earth. *Caspar Hofman* flies to the inequality of the boyling blood, which is like boyling water, part whereof ascends and part descends.

Others do interpret the matter with greater subtilty saying that the blood is changed into an Airie spirit. *Primerose* saies, that blood just as Milk, Honey, and very many things besides, doth exceeding swel and rise, so as to become nothing but a kind of Spirit or light Air. *Leichnerus* saith that of one grain of good blood a great quantity of Cordial Balsam is made: even as by one grain of Odoriferous Gum cast upon a Cole, an whole Chamber is filled with a delicious smell.

But many difficulties stand in the way of this Opinion.

1. No boyling is of it self equal, but the Pulse is sometimes equal.

2. The Pulse should be greater according as the Boyling is greater. But the boyling of the blood is greatest in burning Fevers, by reason of the extremity of bubbling heat and the various nature of the Blood, yet is the Pulse in such cases very small, and in Putrid Fevers it is evermore little in the beginning according to *Galen*.

3. In live Anatomies, if you wound the heart or the Arteries near the heart, pure blood leaps out abundantly, not frothy, nor boyling, nor heaving, and it continues as it came forth. Nor can it in a moment of time, either boyl in the Heart or Leave boyling, if it did boyl. Yea and if in two Vessels you shall receive the veiny blood out of the Cava near the heart and the Arterial blood out of the Aorta near its original, you shall find no difference: neither at the first, nor afterwards. This *Harvey*, *Waleus*, and as many as have made trial can witness with me.

4. It cannot all be turned into pure spirit by the heart, nor ought it so to be. Not the former, because there is not so much heat in a sound heart, nor can the blood taken out of the Arteries set over a great fire be all extenuated, as *Commingius* hath observed. Not the latter, because the parts for whose nourishment it is ordained, are not merely spiritual.

5. Plunging into cold water would assuage the boyling. But the Arm being hard bound till it swel and grow red again, and then thrust into most cold Water or Snow, when you unbind the same you shall perceive how much the Blood returning to the

Heart doth cool the same, as *Harvey* hath taught us.

The most subtile *Renatus des Crates* and *Cornelius Hogelandius*, and *Henricus Regius* who tread in his footsteps, with equal commendation, do after another manner demonstrate the motion of the Heart to proceed from a Drop or two of blood rarified: when the Ventricles of the Heart are not distended with blood, of necessity two large drops do fall thereinto, one out of the Cava into the right Ventricle, another out of the *venosa Arteria* into the left, because those two Vessels are alwaies full, and their Mouths towards the Heart are open, which drops because of their aptness to be dilated, and the heat of the Heart, and the remainders of blood therein burning, presently they are set on fire and dilated by rarefaction, by which the Valves through which the drops entred are shut and the Heart is distended. But because of the straitness of the Ventricles, the blood rarifying more and more cannot there abide, therefore at the same moment of time, it opens in the right Ventricle the three Valves of the *Vena Arteriosa* which look from without inwards, and being agitated by heat, it breaks out through the said *Vena Arteriosa*, and by distending the same and all its branches and driving on the blood, makes them beat the Pulse: but in the left ventricle it opens the three valves of *Arteria magna* looking from without inwards, and through them breaks into the great Artery, which it widens, and drives the next blood warmed and expelled by the former pulsations, into the rest of the Arteries of the whole body, that they might be thereby distended. And so they conceive the Diastole is caused. And they say the reason of the Systole is, because the blood being expelled out of the ventricles of the Heart, the Heart is in part evacuated, and the blood it self in the Arteries cooled, wherefore of necessity the heart and Arteries must flag and sink, whereupon way is again made for two drops more to enter, that so the Diastole may be repeated.

I dare not deny a light Rarefaction from a gentle heat, such as we observe in the opening of a Vein, and I grant that it may be sometimes praternaturally augmented; but that a few drops should be rarified into so great a bulk, as to cause the motion of the Heart, and that they should be cooled in the Arteries, many Arguments, besides those before those opposed to the Ebullition of the blood, do dissuade.

1. Living Dissections, in which neither when the Heart, nor when the Arteries are wounded, does the blood come out drop by drop or rarified, but pure, such as the Ear had forced out.

2. The Heart being cut in pieces or pricked, is seen to pulse, without any rarefaction of blood, which is but imaginary.

3. In strong Dogs the point of the Heart being cut off, *Waleus* observed, that when by reason of the Efflux of Blood, it was not half full, it was nevertheless erected, but not filled by rarefaction: but when it was contracted, that portion of blood which remained in the Heart, was cast out to the distance of more then four Feet. It is in vain to call in the outward Coldness of the Air as an assistant cause: for the blood in the Heart doth not grow cold in a moment, the heat thereof being yet Vigorous, as a boyling pot taken from the fire and uncovered doth not immediately cease to boyl but after some time.

4. *Jacobus Back* doth elegantly devince the same from the structure of the heart and its Vessels. For the Musculous flesh of the heart being firme and

Hh

strong,

strong, is unapt to rise and fall by the bare Rarefaction of the blood. A more vehement action is requisite to move this vast bulk. Also the Arteries of the heart should have had a greater Orifice, and the rarefied blood being to go forth would require a larger space, then was necessary for its entrance.

5. A Confusion would arise in the motions of the Heart and valves, as he observes. The Diastole of both of them would be performed in the same time, and so the valves should be useless, both which is repugnant to experience. Moreover the valves must be both shut and open, in the Systole of the Arterie.

6. That it should be cooled in the Arteries, neither reason or ocular inspection will permit. It is drawn hot out of the Arteries, differing little or nothing from that which is contained either in the Heart, or near it. In the small Arteries there is indeed no Pulse felt, but that is to be imputed to the smallness of the vessels and their distance from the Heart which forces the blood. Nor ought it because it enters into the Capillary Vessels, that it may nourish the parts with hot Blood, not with such as is cooled and thickened, before it is changed into the secondary humors. And what use is there of rarefaction, if it presently fettle again.

The Experiments and Reasons which learned men bring to the contrary, from an Eele and an hunting dog, from the contraction of the members by Cold from palpitations, from spirit of wine resembling the Pulse, from vehement protrusion &c. are easily answered if you consider

1 That a certain motion is restored even in Hearts that are dead, by exciting their heat as in Muscles.

2 The Fault is in the Vessels contracted by Colds not in the Blood. when they fall in and flag.

3 Palpitations arise from plenty of blood, as examples testifie, suppression of the Courses, and the cure by blood-letting.

4 In the Heart there is an even motion, different from that which raised by spirit of wine or any thing else.

5. The protrusion by pure blood is more vehement, if the faculty concur, and the Fibres of the Heart be united.

6. The Heart is in its Perisystole or very near it, when in the point cut off, no dilatation is observed, if it continue still in the Systole, the dilatation is not felt, till the Diastole follow.

Whether there be a pulsifick Faculty.

The pulsifick Faculty implanted in the Heart, must needs be joyned with the blood as the cause of its motion, either that it may guide the influx and egress of blood, and assist the same, which would otherwise proceed disorderly, as I explain the matter; or that it might of it self produce the motion, according to the Opinion of the Ancients, which cannot be conserved, if the perpetual flux of the blood should be stopped. That the Heart stands in need of such a faculty I prove

1. Because the Pulse would be alwaies unequal, the influx being unequal, unless directed by some Faculty.

2. When the Heart in Feavers is more vehemently moved then ordinary, through the urgency of heat, and in dying persons Nature being at the last pinch, and using all her might, yet is the motion of the heart weak, as appears by the Pulse, because the inbred Faculty is either lost or weakened. Contrariwise, though the said Faculty be strong, and the influx of the blood cease or be hindered, after large bleedings, or by reason of Obstruction of the Vessels, either in the whole Ha-

bit of the Body, or the passages thereof, or near the Heart, the Motion of the Heart fails. And therefore both are to be joyned together as primary Causes.

3. Any Particles of the Heart being cut off, do pulse by reason of the reliques of this Faculty or Spirit remaining.

4. The Heart being taken out of the Body, or cut in pieces, lightly pricked with a pin, does presently pulse, as *Waleus* hath observed.

5. It were contrary to the Majesty of the principal Part, to be moved by another whether it will or no, without any assistance from it self, and so to receive a violent Impression.

Regius hath substituted the influx of Animal Spirits into the fibres of the Heart instead of Animal Spirits, and *Hogeland* the little petite Atomes of the blood moved in the Parenchyma. But we must know in the first place 1. That the motion of the Heart is Natural which lasts perpetually, yea against our wills, and when we are asleep, and not Animal. 2. That we exclude not the Spirits, which are the Souls Servants and Instruments. 3. The small Boddikies or indivisible Particles of the Blood, have all dropped out in dissected Hearts, because the *Vena coronaria* was cut asunder. And that if any reliques of the said Boddikies did remain, they could not be excited to motion, either by pricking alone, or by raising heat, unless a Spirit or Faculty be allowed, which being extinguished, though the pieces of the Heart be laid in never so hot a place, they will never pant.

Among the *Remote Causes* there is

1 The vital Spirit, as well that which is implanted in the Heart, as that which comes thither from without, with heat sufficiently manifest in

Remote Causes of the motion of the Heart.

live dissections, and which warms the whole Bodie. And that either not *shining with light*, as most will have it, or *shining*. That a lightfull hear of the Heart is requisite in this case, many things argue.

1 The motion of the Elements is simple, never circular, and light moves it self and the humors with a circular motion. 2 The Heart and the Blood are more quickly moved by light then otherwise they could be, which in the twinkling of an eye, dazeles all things, illuminates all things. 3 There is in all particular parts besides the obscure principles of the Elements, also a lightfull part propagated from the seed, which ought to be preserved by a like flame, kindled from the Heart 4 In *Hippocrates* to dream of pure and brightly shining starrs, signifies Health of Bodie. 5 No Humor although hot, does pant and move it self, unless a burning flame, as we see in spirit of wine, a Candle, and other things. 6 In Glow-wormes their hinder-part only pants and shines, where their Heart is, of whose light I have discoursed in my *Second Book of the light of Animals* Chap 11 and 12. That the vital spirit is really endued with light, and that there is an inbred light in the Blood and Heart, which helps forward the circular motion of the blood, I have demonstrated in my said Treatise Lib. 7. Cap. 5. 23. *Helmont* consents that the animated spirit, in the left Ventricle of the Heart, inlightened by the former light, is the Mover of the Heart. After *Caimus* and other ancient Authors, *Em* asserts the same thing touching the flame, raised out of the Seed in the first bladder of the Heart raised by the heat of the Hen which hatcheth, and first of all shining forth, when the Lungs perform their office. yet he errs, that in the external widening he begs, in the Construction more inwardly he tends to the beginning: for in the Systole all that illuminates

is expelled, and then it is vigorated in a narrow heart, which is evident in optick tubes and hollow glasses. I add that in the Diastole of the left Ventricle, it sets on fire and kindles by the Systole from the Lungs, the vital flame.

2. The Shape and Conformation of the Heart and Vessels being exceeding well fitted to receive and expell the blood. Especially the *fibres* of the Heart, and the *fleshy columns*. These make not so much for the Strength of the Heart alone, as for the motion. For all the fibres being contracted greater and lesser, in the walls and septum, which according to *Harvey* are circular, as in an artificial Net, or Purse squeezed, the contents are expelled. They are stretched in the Systole, and remitted in the Diastole. By help of the smaller fibres, wherewith the flesh is interwoven, a *languishing* constriction is made, but to a *stronger*, those greater fleshy ones concur contained in the Ventricles, which *Waleus* often observed in live Bodies dissected.

3 The Pulse of the Heart, the Blood and the extrem parts, the pulse is from the Heart, which ceasing, the motion also ceases. Now it begins from the vena cava, and is continued from the Auricula dextra, by and by from the right ventricle into the Vena arteriosa, or if the point be cut off, externally from the *Arteria venosa* into the left Earlet, thence into the left Ventricle, out of which the Pulse is felt by a manifest constriction to goe into the Aorta, in the Anatomy of living Creatures.

They drive, because 1. The Blood is offensive by its Quantity. 2. They are moved being irritated by any external force. 3. Blood is continually suppetuated. For Blood thrusts and drives on Blood, so that even after the Heart has bin taken out of Bodies, *Waleus* has seen a quick motion of the blood in the veins. Which nevertheless did not happen by any proper power, which the Blood has to move it self, but partly by the driving of the *external parts*, which remitt or send back that which remains after nutrition as *burnt* ensoine and superfluous, partly by a spontaneous contraction of the Vessels filled with Blood, whose Arteries in living Bodies being bound towards the Heart; do swell; towards the extrem parts they are empty: But the Veins too near the smallest branches and the parts from which they bring back the Blood are puffed up, but are flat where they look towards the Heart, to which they drive the Blood; in a word, partly by the contraction of the *muscles* and their driving, in the fleshy and outward parts, as *Harvey* observes.

4 The Attraction of the Heart and Parts, least they be destitute of aliment profitable and sufficient for them, which we observe according to Nature in those parts that are nourished; but besides nature in wounds, Ulcers, Tumors, &c. And this may easily be done, because the blood dispersed in all places, is immediately fastened to the Heart and Parts which draw it, the Pulse of the cava and Arteries assisting the same.

Chap. VII.

Of the parts of the Heart in special, viz. the Earlets, Cavities, Septum, Vessels, and Valves.

The parts of the Heart which are specially to be considered, are either externally seen as the Earlets;

or within only, as the Ventricles or two Cavities, the Septum or partition, and the Vessels with the Valves.

The Earlets or little Ears, were so termed, not from hearing, but because of some resemblance in their shape. For from a long Basis they end in a blunt point (howbeit the left is more accumulated) of an obtuse triangle; and they have a Cavity, that the Ventricles might be produced before the Heart. For that same pulsing Bladder in an Eg, is the Earlets, because they were necessary in the Child in the Womb, though the Heart were not so soon necessary, which afterwards

The Earlets of the Heart why so called?

What pulses first in an Eg.

grows upon the Bladder. Others give another reason, because the Earlets observe the same proportion in their pulsing as the Bladder had. But this is very hard to distinguish in the first Generation. Others take the Bladder for the Heart, whose Expansions or Earlets appear red, because they are transparent, but the Heart is not seen by reason of the plenty of Seed, and Pulse intermitted. I suspect that both may lie hid under the *Vesicula* or bladderkie, but that the Earlets are presently drawn and moved, because of their use. Otherwise it would seem inconvenient that the Appendix should be greater than the whole Body. Nor is the Heart a bare Parenchyma or affusion of blood. It hath Cavities produced doubleless out of the foresaid Bladderkie.

Now the EARLETS are Proecesses or Appendixes; and according to *Hofman*, nothing but the Substance of the Heart attenuated and widened. Which I know not how true it is. I should rather say they seem to be the substance of the neighboring Vessels dilated, although they are made first of Seed out of the bladder, and are the first motion, and the last in dying.

They are situate at the Basis of the Heart, before the Orifices of the vessels venal to which they cleave, and whereby they are mediately joyned to the heart. They are on each side one

Their Situation.

For two they are in Number, answerable to the number of the Hearts Ventricles, the right Earlet being greater, and the left smaller. And both are large in an Embryo or Child in the Womb: the former is joyned to the Vena cava, with which it seems to be one common body; the latter to the Vena arteriosa.

The Substance of the Earlets is peculiar, such as there is none in any other part; by reason of their singular use. Howbeit they are thin and soft, for their more easie contraction and nervous for strengths sake. But the left is more hard, a little more fleshy and thicker: yet the Heart is not so. Howbeit they answer in a certain proportion to the Ventricles of the Heart.

Their external Surface, when they are extended and full, is even and hol-
sie or bunching (but their circumference unequal) when they are contracted, it is wrinkled; and in the left it is more wrinkled than in the right, because the inner fabrick is more turning and winding, and hath more pits in it, for

Their Surface.

The Earlets being inwardly dissected and spread open, do discover unto us 1. a certain flesh-membranous plain, stretched out to the extremities of the treble pointed Valves, to which the fibres of the Valves are fastned. 2. About the whole circumference fleshy Columns grow out, first the great crooked ones,

out

out of which Spring many lesser ones, with a wonder-
ful and neat contexture, sometimes single, sometimes

See Tab. IV.
of Book II.

wreathed, and infolded either with
the great ones, or with one another.
3. Between these Columnes deep
Pits are seen, more in the left, fewer
in the right. In the middle partition of each Earlet.
Folius hath found out many little Holes, which I have
also seen, through which he conceives the blood is car-
ried into the left Ventricle, when there is need of less
matter. But seeing they are rarely to be seen, nor do
they penetrate into the Ventricles, yea they are less, I
am more apt to think they are Pores common to ma-
ny, serving for motion, or the nutrition of the Part.

Botallus hath found a Passage sufficiently visible near
the right Earlet, which goes presently right out, into
the left Ventricle. This *Waleus* explains to be ment
of the oval hole, or that passage by him observed,
which goes obliquely out of one Earlet into the other.
Such an one I have often seen in Oxen and Goats, but
it is the coronal Vein, nor does it pierce into the left
Earlet, but descends into the Parenchyma of the heart.

As to their Colour: In an Infant in
the Womb some months old, they are Their Colour.
red, by reason of the abundance of pur-
ple blood, according to the Observation of *Harvey*. I
have observed the same in the Conceptions of beasts,
the Heart being white and bloodless, and the Earlets

The FIGURES Ex- plained.

FIG. I.
Shews the Heart cut in sunder
athwart.

- A. The Basis of the Heart.
- B. The Point of the Heart.
- C. The right Earlet.
- D. The left Earlet.
- EE. The Shape of the left Ventricle like an
half Moon.
- FF. The Cavity of the left Ventricle.
- GG. The partition between the Ventricles.

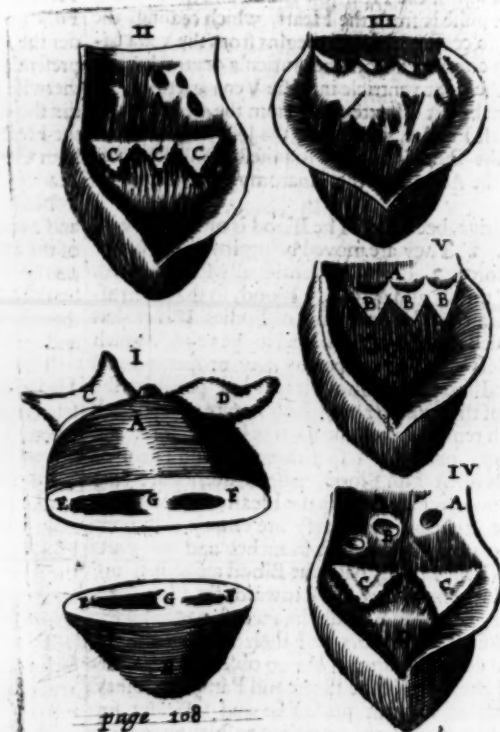
FIG. II.
Shews the Vena cava with the right
Ventricle dissected.

- A. The Orifice of the Coronary Vein.
- B. The Appearance of an Anastomosis,
between the Vena cava & Vena pul-
monalis.
- CCC. The trebble-pointed Valves with the
Fiberkies wherewith they are fastned.
- D. The Ventricle cut long-ways.

- FIG. III.
- A. The right Ventricle of the Heart ope-
ned.
 - BBB. The Sigma-fashion'd Valves, visible
in the Vena arteriosa.

- FIG. IIII.
- AA. The Arteria venosa dissected.
 - B. The Print of an Anastomosis between
the Arteria venosa and Vena cava.
 - CC. The two Mitre-shap'd Valves.
 - D. The left Ventricle opened.

- FIG. V.
- A. The great Artery cut asunder near the Heart.
 - BBB. The Semilunary Valves, in the Orifice of the great Artery.



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full of blood and ruddy. In grown persons they are
commonly more obscure then the Heart it self, when
they move not, but in their motion they successively
change their colour, as the Heart does; for being mo-
ved they are pale, because they expel the blood in their
contractions, which does most of all appear in their
extremities; they grow red again in their Diastole,
when they have received blood.

Their Motion. Their Motion is manifest to the sense
in live Anatomies, by reason of the
blood rushing in, and filling them,

wherewith they swell in living bodies, and by their
contracting themselves, by means of their fleshy fibres
contracted into themselves, endeavoring to force the
blood out into the Ventricles.

There are three parts of their motion; *Systole*, *Dia-
stole*, and the rest or pause which comes between them,
which cannot be discerned, save in persons ready to
die, for they are performed so swiftly in sound persons,
that they seem to be confounded, and to be perform-
ed all at once, as in the discharge of a Gun, all seems
to be performed in the twinkling of the eye, and in
swallowing, as *Harvey* informs us.

The

The *Diastole* is caused by the blood received from the *Vena Cava* and *Arteria Venosa*. The *Systole* is performed; when the Earlets being filled, do by contracting themselves, expel the Blood into the Ventricles.

The *Diastole* and *Systole* of both the Earlets, do happen at one and the same time. When the right Earlet undergoes its *Diastole*, at the same time the left Earlet undergoes the same; when the latter is contracted in the *Systole*, the former also expels. But the *Diastole* of the Heart and Earlets, happens at different times, as also both their *Systoles*. The *Systole* of the Earlets happens at the same time with the *Diastole* of the Ventricles, and contrarily, and the contraction of the Earlets doth alwaies forego the *Diastole* of the Ventricles, both in healthy persons and in such as are at the point of death. But the motion of the former is more lasting then the motion of the latter. When the left ventricle ceases, the left Earlet still continues pulsing, which being extinct, the remaining motion is in the right ventricle. and that ceasing, the right Earlet proceeds panting, being the last that dies, save that when it ceases, a certain trembling motion doth as yet continue in the blood which flows in, by reason of the driving of the extreame parts.

Their use, is I. To be Store-houses to the Heart; for they first received the Blood and Air, that they may not suddenly rush into the heart, whence the heart might be hurt, and the Animal faculty suffocated. And hence it is that they are placed only at the vessels which pour into the heart, and not at the Arteries which void the blood forth.

II. To safeguard the vessels to which they are joynd.

III. To be instead of a cooling Fan to the Heart, according to *Hippocrates*.

IV. According to *Walaus*, to be in place of a measure, by which the *vena Cava* and *Arteriosa* do measure the blood into the heart, for seeing all the blood was not to go out, at every pulse, but the greatest part was to stay behind to be further perfected, nature joynd the Earlets to the heart, as vessels which should give in so much blood to the Heart, as was naturally to be cast forth at every pulsation. For which cause he thinks it is, that the right Earlet is greater then the left, because the right Ventricle is more Capacious then the left, and like more is voided therefrom then from the left, viz. sooty Exhalations and the Nutrient of the Lungs.

The Ventricles of the Heart.

Aristotles Error.

The CAVITIES of the Heart or its Ventricles, Chambers, or Caves &c. are not three, as *Aristotle* falsely ascribes to greater Beasts, for three are not found, no not in a Whale, but only two, as *Walaus* and *Sylvius* have observed in the dissection of a young Whale. Nor did *Galen* at Rome find more in an Elephant. And by a very rare chance three were observed by *Emilius Parisanus* at Venice in the Heart of a certain Coverlid-maker. And *Veslingius* twice observed the like. Also *Walaus* saw a third Ventricle in the Heart of an Oxe. *Cesalpinius* observed three in Birds and Fishes, and the right Ventricle doth easily appear to be divided into two near the point, by a certain thin Partition, yet in truth both come into one. *Licetus* understands that same third Ventricle of *Aristotle*, to be the Prominency of the right Ventricle, turned in beyond the left, so that the left Ventricle commonly so called is *Aristotles* middle Ventricle. *Conringius*

doth otherwise excuse *Aristotle*, viz. that the right Ventricle in his account is whence the *Cava* arises, the middle whence the *Aorta* springs and the left, whence the *Arteria Venosa* or left Earlet arises, which being the least of all, is in final Live-Creatures hardly visible. But so there should be four Ventricles, the *Vena Arteriosa* being added, as at first sight may seem, not three only. There are therefore only two Cavities found in the Heart of a Live-wight, the right and the left, having their inner surface uneven and rough, especially the left. The Heart of a certain Polander cut up by *Riolanus*, was perfectly solid, having no Ventricles at all.

Many Pits are formed in them by the fleshy Fibres, in the right more, but narrower, in the left fewer, but deeper, that they might contain the blood received in, hence in the Constriction of a Living Heart they are lesser, in the Dilatation wider. The Pits are constituted and fenced by

Those fleshy Particles termed *Lacertuli Musclicies*, sometimes round, sometimes thin, being five or more in the right, two only visible in the left, but very thick ends. *Veslingius* observes that the larger have Pores which pass through them. The use of them, is according to some, to be Ligaments of the Heart. *Massa* counts them little Muscles. *Vesalius* and *Riolanus* call them *Columnae carnea*, fleshy Pillars, which being contracted, do further the *Diastole* of the Heart. *Parisanus* saies by help of them the Heart contracts it self, *Walaus* also hath observed in live Dissections, that they assist the Contraction or *Systole* of the Heart, especially when it is strong and vehement, at what time their swelling begins at their Basis, and goes on by little and little unto the point. *Harvey* saies they draw the Cone or Point of the Heart to the Basis or broad end thereof, by their oblique fibres. And he is apt to think that heat is carried through all of them. *A. Benedictus* and *Ent*, that they hinder the blood from going into Clotters, while it is shaken and agitated by them. *Bacchius*, that they are instead of Ropes and Bands, to hinder least in the Contractions of the Heart, the Valves being forced beyond their pitch and overshot, should be unable to retain the Blood. *Slegelius* will have it that they are contracted, that they may shut the Orifices of the Vessels of the *Cava* and *Vena Arteriosa* by their Fibres. All these Opinions are true and must be joynd together, as will manifestly appear to him that shall accurately consider the times of the motions of the Heart.

Many things are preternaturally found in the ventricles of the Heart. *Baubin* hath found bits of fat, and our most expert Countryman *Wormius* hath took out of both the ventricles certain Caruncles or final particles of Flesh, whitish within, but of a shining red color without; which I also have long since found, at *Padua* and at *Hafnia* in my Dissections, both of Men and Beasts, *Erasmus* hath found a Flegmatick concretion, like yellow marrow, which is found, in the boyled bones of Oxen. *Vesalius* two pounds of Glandulous and blackish flesh, *Benivenius* a Gobbit of flesh like a Medlar.

Salvius hath observed Worms, as also *I. D. Horstius* at *Confluentia*; May a twibled Snake like a Whip at *London*, and *M. A. Severinus* much such another at *Naples*. *Hollerius* found stones (with an Impostume) in a woman troubled with the stone; and *Wierus* stones as big as Pease.

Fleshy Pillars in the Ventricles of the Heart.

Things preternatural found in the Heart.

A Bone in the Heart. Bones are more rarely found in the Hearts of Men. Yet *Gemma* did once find some, and *Riolanus* twice, in the dead body of president *Nicolas* being eighty years of Age, at the beginning of the Aorta, and in the Queen Mother of *Levin* the thirteen King of France, being after her decease opened to be Imbalm'd. *Johannes Trullus* found one in the Heart of Pope *Urban* the eighth of a triangular Figure representing the letter T. *Simon Pauls* my Renowned Predecessor in the Anatomical Theatre, took a bone as hard as a stone of a Figure of the *Pythagorean* letter Y, out of the Heart of a Man of *Hafnia* forty years of Age, the bigness of a Walnut, and the shape not unlike the Heart. I conceive they are all bred through the dryness and slow motion of the Humors in aged and sick Persons. Yet nature makes use of this defect to provoke and quicken the motion of the blood, when it passes slowly, as waters flow more easily when a peice of wood is cast in, or that all the blood may not clotter, as our Women and Butchers stir their blood about with a stick, when they intend thereof to make Puddings, that it may not go into Clotters.

The right Ventricle. The right Ventricle receives blood out of the Vena cava, which Vein it receives into it self: And therefore it hath not so thick a flesh or wal, as the left hath, that their might be an even poise, seeing it contains more matter, and bears a greater weight then the left. Nor is there so perfect a Concoction made in this Ventricle, as in the left in which there is more heat.

It is not exactly round but semicircular, resembling the Moon encreasing, nor does it reach to the End of the Point, but it seems to be as it were an Appendix to the left Ventricle, which when the left is taken away, seems still as it were to represent an whole Heart.

Yet is it deeper and larger then the left, by reason of the store of blood, which it was to contain, both to nourish the Lungs, and to make vital Spirits in the left Ventricle. For

Its Use is 1. To receive blood out of the vena cava, to nourish the Lungs, the said blood being poured into the Lungs through the *Vena arteriosa*. Therefore Fishes which have no Lungs, and draw no Air in at their Mouths, are without this Ventricle, having no more then one. This right Ventricle therefore, does concoct and attenuate the Blood, for the Nourishment of the Lungs.

II. To send the thinner part of the Blood through the Septum or partition, into the left Ventricle, to make vital Spirits; and the thicker part through the Lungs, both to nourish them, and that it may return to the left ventricle, for the Nutriment of the whole Body.

III. Further to perfect and prepare the blood which runs back as superfluous after the extreame parts are nourished, and the crude blood which is bred in the Liver.

The left Ventricle. The left Ventricle is narrower, but more noble; having a round Cavity, and which reaches unto the point of the Heart. Its flesh or wall is three times as thick as that of the right ventricle. Also it is harder, that the vital Spirits may not exhale, and that the motion of the blood might be stronger, being to be forced into the farthest parts of the body.

Its Use is to make vital Spirit and Arterial blood, of a twofold matter, 1. Of blood prepared in the right ventricle, and passed through the Septum and the

Lungs. II. Of Air drawn in by the Mouth and Nostrils, prepared in the Lungs, and transmitted through the *Arteria venosa* with the blood into the left ventricle of the Heart, to kindle and ventilate the vital flame, yea and to nourish the same. The latter fishes stand in need of and Leucophlegmatick persons, the former such as are seated in a narrow or infected place, or are under extreame heat, for fear of suffocation and extinction of the flame in the Heart.

The Use therefore of both ventricles is in a manner the same, viz. to generate Arterial blood, and to perfect the venal, and to receive the same running back from all parts of the body through the veins, and to expel the perfect blood through the Arteries into the farthest parts of the body, that they may be thereby nourished. This is proved by the Conformations of the ventricles, which in part are like one to the other, in the right two vessels, a Vein and an Artery carrying out, and bringing back, and as many in the left. In the former are two sorts of Valves the trebble pointed, and Mitre-shap'd, and the like in the latter. The left expels and receives as much as the right, save that it is consumed in nourishing the Lungs and the Heart. Yet their different Constitution and Magnitude, argues some difference. Whence 1. There is a different Coction in the one and other, as hath been demonstrated above. 2. The right works for the Lungs the left for the whole Body. 3. The right sends forty Exhalations and blood to the Lungs; the left receives from the Lungs Blood Impregnated with Aire.

There is a Septum or Partition between the two Ventricles, which is thick like the other Wall of the left ventricle (which *Columbus* once observed to be Griftley) hollow on the left side, on the right bunching, full of hollowneses and holes, which some suppose to be the third ventricle of *Aristotle*; which hollowneses or Caves are more large towards the right side, but their utmost ends towards the left side are hardly discernable. *Helmont* describes them to be triangular, whose Cone ending in the left ventricle, is easily stopped, but the Basis of the said triangle in the right ventricle, is never stopped save in Death. But I have seen them Circular so that they could easily admit a Pease, but, obtuse towards the left Hand.

That they are open is the opinion of the Ancients and of many Anatomists which follow them. *Gassendus* saw *Payanus* at *Ajax* shew the

Manifest Pores in the Septum of the Heart.

Septum of the Heart to have through-fares, by reason of sundry windings and crooked Conv-holes as it were, and that by lightly putting in his Probe, without any violence, which he wreathed gently and turned it upwards and downwards and to the sides. And although by a Probe breaking the tender flesh of the Septum, we may easily make a way, yet we may not doubt of the Eyewitness of *Gassendus* nor of the Dexterity of *Payanus*; seeing I also of late found the partition of a Sows Heart, in many places obliquely perforated with manifest great Pores, which were open of themselves without the use of a Probe, so as to admit a large Pease; but when I put in my Probe, it brought me to the left ventricle, where a thin Membrane as it were an Anastomosis was placed, hindering any regrefs. *Riolanus* also hath seen it bored through towards the point, where it is most thin. *Waleus* in the Partition of an Oxes Heart, did sometimes find a Cavity in the upper part according to the length of the Heart, open into the left ventricle about the point

of the Heart, the length and breadth of a Mans Forefinger, which he conceives to be the third Ventricle mention'd by Aristotle.

Yet are they not alwaies open in dead bodies, because in living bodies they are kept open, by the continual agitation of the Heart, which ceasing, they are not so visible to the Eye-sight, even as we see no manifest passages, when the sweat breaks out plentifully through the Skin, nor when the seed breaks out of the Kernels and Spermatick vessels, into the Urinary passage: nor the Pores by which the Empyema or out of the blood out of the vena Arteriosa pierces into the Arteria venosa, through the substance of the Lungs, or the blood in the Liver, out of the branches of Porta into the Cava. *Celsus* is in the right, where he saies, that nothing is more foolish, then to think that look what and how it is in a living Man, so it must needs be in one that is dying, Yea that is dead. Whence many (as *Columbus*, *Spigelius*, *Hofman*, *Harvey*, &c.) have denyed that any thing passes through this Septum or Partition. But it is no wonder that they make a doubt of it: For,

I. They are so crooked and winding, that a Probe cannot easily pass through them. Howbeit these Pores become more conspicuous, in the Heart of an Ox long boyled, as *Bauhinus*, *Riolanus*, my self with others can witness. And you are to observe, in opposition to *Hofman* and *Plempius* that deny it. that in the boyling a moderation must be used, and that the Fibres in living Bodies do never stick so close together, but that they leave Pores, as the Nerves do shew, finally, that the quickest-sighted Anatomists can see no Membrane in the boyled Hearts of Oxen. II. In dead Bodies all passages fall in and shrink together. III. That an extream straintness was requisite in the End; because the thinnest part of the Blood, is strained as it were in that part: And in the mean time, because these holes are not in vain, therefore,

Whether the Blood pass through the partition of the Heart? The Use of the Septum or Partition of the Heart, is, that the thinner blood may pass there-through into the left ventricle, for the Generation of vital blood and spirit, which is afterwards distributed through the Arteries into the whole Body, for to preserve and stir up the life and natural heat. But the thicker and greater part of the blood, by a natural and ordinary way, and not a violent only, is communicated to the Arteria venosa, through the vena Arteriosa, by mediation of the Lungs, that in the left ventricle it may be mingled with that which sweats through the Septum. The thicker part is ordained to nourish the Lungs, and that it may return back to the left ventricle is tempered with Air. The thinner part passing through the Septum, nourishes the same in its passage, because the external Coronary vessels do only creep through, and in that long and dangerous journey through the Lungs, it would vanish away and come to nothing. By this way only such as dive deep into the Sea, and those that are hanged for a small while, do live a while and come to themselves, after the motion of their Lungs is ceased.

The Motion of the Septum or Partition doth help forward this passage, which that it is moved according to the motion of the Ventricles, I have these signs and tokens; Because 1. It is furnished with Circular Fibres, as well as the Walls, in a boyled Heart, such in a manner as are in the Sphincter Muscle, as *Harvey* justifies, which seeing them move the Ventricles, they must as well move the Septum. 2. A certain Palpi-

tation is felt, if you put in your Finger into a living Heart, according to the observation of *Walens*. 3. In Creatures ready to die, when the motion of the left ventricle ceases, the Septum follows the motion of the right Ventricle, as the same *Harvey* observes: and if the right Ventricle be wounded, *Riolanus* tells us, that the motion remains in the Septum in his Observations. Yet the same *Riolanus* in another place being wiser, denies that it is moveable, unless towards the Basis where it is soft gives way a little, and that so it ought to be that the passage may be maintained, because when the Ventricles are dilated above the through-far'd Septum, and straitned again like Bel-lows, the little holes would be shut up. But there is no fear. For in the Systole, when the point is drawn back to the Basis, the Pores are opened in the Septum moved upwards, that the blood may at once pass both the Septum and the Lungs. Contrarywise in the Diastole, because the Heart is distended long waies, the pores are drawn back with the Septum, and are shut up, until the Heart be filled.

As to the Heart-vessels there are found Vessels of the Heart. four remarkable ones going out of the Heart which *Hippocrates* calls the Fountains of Humane Nature. Into the right Ventricle are inserted two Veins: the Vena Cava and Vena Arteriosa; into the left, as many Arteries; Arteria Venosa and Arteria Magna. Before all which are placed within eleven Valves or little doors, made of the Tunics of their Vessels widened and stretched out. The Veins which bring in to the Heart, viz. the Cava and Arteria venosa, have trebble-pointed valves, looking from without inwards; the Arteries which carry away, viz. the Aorta and the Vena Arteriosa, have Sigma-shap'd or Mitre-fashion'd valves open inwards, shut outwards. The former admit blood into the Heart; being open they suffer the blood to flow out, being shut they hinder it from returning the same way. The trebble-pointed valves do not only wink, but they are close shut by the blood distending the Heart, and by the constriction of the Heart which straitens the vessels. The Sigmoides or Sigma-shap'd are shut by the Relaxation and falling in of the Heart in the Diastole, whereby the Fibres being stretched out long-waies, they are drawn downwards with the Walls and so shut, like the Chains in Draw-bridges.

The Trebble-pointed or Tricuspides, are opened by the impulse of new blood through the Cava, and Arteria venosa, and the Diastole of the Heart, whereby the Fibres being drawn downwards, they are opened; But the Mitre-shap'd valves, are open'd in the Systole by the Constriction of the Heart, and the blood urging its way out. Also they may be praternaturally shut, by the blood expelled and standing sealed in the full vessels, to which, endeavouring to run back, they make resistance by reason of their conformation, which Artifice of Nature, we see every where imitated by the Flood-gates and Locks made upon Rivers. But that according to nature they are not shut by the returning of the expulsed blood, as some conceive *Walens* proves, Because 1. Our senses observe that the blood is carried from the Heart, not to the Heart by the Arteries. 2. In a rare and languishing Pulse, the Artery doth not rise or swell last in the upper part towards the Heart, but it swells there first. 3. If an Artery be tied two fingers from the Heart, and it be so opened betwixt the Ligature and the valves, that the blood may freely pass forth, yet the valves will divers times straitly be shut, and the Heart is orderly moved.

The Explication of the FIGURES.

This first FIGURE shewes the right side of the Heart entire, and withall the Earlet cut off, and the Vessels which goe out of the Heart, but especially the Anastomosis by which *Folius* will have the Blood to flow from the right into the left Ventricle.

FIG. I.

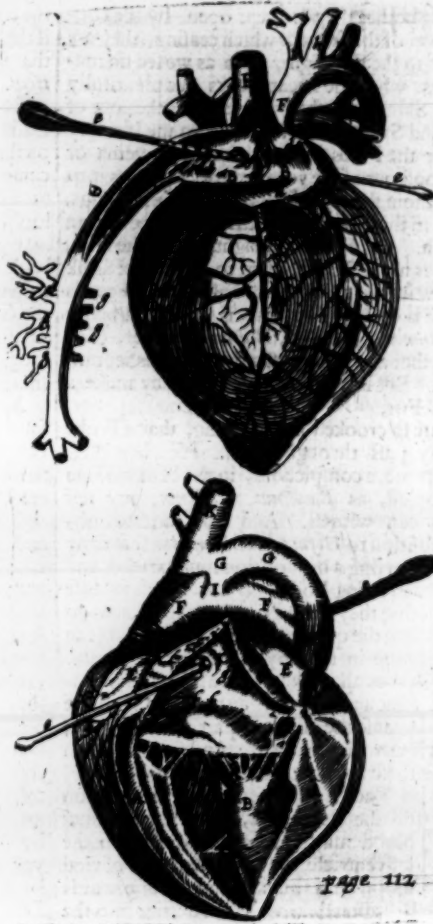
- AAA. The Heart in its proper posture, over the Surface whereof, the *Vena Coronaria* is disseminated.
 BB. The right Earlet of the Heart, partly dissected, partly intire.
 C. A certain white and circular place between the Earlets, in which on one side, under a certain little skin like a valve, an Anastomosis is found, that is a wreathed winding hole, through which *Folius* will have the Blood to pass, into the left Ventricle.
 D. The *vena cava* dissected, as far as to the Situation of the Liver.
 E. The *Vena Aorta* which goes to the Throat and Arms dissected.
 F. The *Arteria magna* ascending.
 G. The same descending near the Back-bone.
 H. An Arterial Pipe, which joins the great Arterie with the *Arteria venosa*.
 I. The *Arteria venosa* issuing out of the right Ventricle of the Heart.
 K. The *Vena Arteriosa*, Nurse of the Lungs, issuing out of the left Ventricle.
 aaaa. The *Vena coronaria* radicated and diffused through the surface of the Heart.
 b. The beginning of this *Vena coronaria*, in the Earlet near the *Vena cava*.
 cccc. A certain portion of the Earlet dissected.
 dd. The other part remaining yet intire.
 ee. A Probe thrust into the Anastomosis.
 f. A little skin like a Valve placed at the mouth of the Anastomosis.
 gggg. The Branches of *vena cava*, spread up and down and rooted in the Liver.
 hhh. Ascendent branches of the *Arteria Magna*.

FIG. II.

This other Figure shewes the left Ventricle of the Heart, as also the Earlet dissected, together with the going out of the Probe, demonstrated in the first Figure.

- AA. The Heart cut open through the whole left Ventricle.
 BBB. An exact Representation of the said Ventricle.
 C. The Egress of the Probe, through the Anastomosis, from the right into the left Earlet.
 D. A Valve placed at the mouth of the great Arterie.
 EE. The left Earlet of the Heart dissected, being left then the right.

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- FF. The *Arteria Venosa* going out of the right Ventricle of the Heart.
 GG. The *Arteria Magna* ascending.
 H. The said Arterie descending near the Back-bone.
 I. The Arterial Pipe knitting the *Vena Arteriosa* to the *Magna Arteria*.
 K. The Trunk of the great Arterie, ascending to the Arms and Throat.
 aa. A certain part of *Vena Coronaria* dispersed through the surface of the Heart, the smallest part thereof is visible.
 bb. The *Arteria Coronaria* dissected.
 cccc. The left Earlet cut open as far as to the *Vena Arteriosa*.
 dddd. Certain Nervous particles, in the very Ventricle of the Heart, accounted Nerves by Aristotle.
 ee. The Probe thrust in through the Anastomosis.
 fff. Certain small holes, through which *Folius* will have the blood to pass, while the Anastomosis grows together, and there is need of less matter.
 g. A Valve on the side also set before the Anastomosis.

And therefore many of the *Ancients* and *later writers* are deceived, who imagined that the blood did freely pass out of the Heart, and back again thereto. And that the valves do not naturally close and open, appears by a Tumor in the Arteries between the Ligature and the Heart, and the emptying of the veins near the Heart.

Vena Cava. The first vessel is the VENA CAVA inserted into the right Ventricle, with a very large and gaping Orifice, three times greater than the Orifice of the Aorta, and therefore it seems rather to arise from the heart, than from the Liver, especially seeing it sticks so firmly to the right Ventricle, that it cannot be separated therefrom.

Whether it hath any motion is hard to determine. *Aristotle* and *Galen* seem to have been of that opinion; but the Interpreters expound those places to mean an obscure motion. But *Waleus* hath discovered a manifest motion therein, from the Jugulum as far as to the Liver, but most evident near the heart: and that therefore even in that place the Vena Cava is furnished with fleshy Fibres, whereof it is destitute in other places. Also *Eur* hath observed that the vena Cava of a dead Beast, being with a mans Finger lightly touched in the Belly near the Thighs of the Beast, did express a trembling motion.

Its Use is, to bring in Blood from the Liver, and the whole body, by its ascending and descending Trunks.

A Membranous Circle grows to the Orifice thereof, to strengthen the heart: Which is presently split into three strong Membranous.

VALVES, termed *Janitices*, Gatewarders, looking from without inwards, that the blood may indeed enter; but not return back into the Cava.

Its treble pointed Valves. They are termed TRICUSPIDES, treble-pointed, by the Greeks *Tricholochines*, because they are like the Triangular heads of Darts, when they are shut, and fall close one to another.

They grow, as also the rest of the valves do, to many threads (in the Cava commonly each one to five remarkable Threads, interwisted with many little ones) whereby they are joyned to that fleshy part, before explained; which some call the Ligaments of the heart, others as *Aristotle* perhaps, the Nerves of the heart.

The Vena Arteriosa, why called a Vein? The VENA ARTERIALIS or vas Arteriosum, the Arterial veins or Arterial vessel. Others call it *Arteria Pulmonaris*, the Lungs Artery, because it is in truth an Artery, both in Substance and Use.

Twas called a Vein first by *Herophilus* and afterwards by most other Anatomists, before the Circulation of the blood was found out, from its Office, because it sends blood to nourish the Lungs.

Why called an Artery? Tis termed an Artery, I. By reason of its Substance, which consists not of a single Coat, as a vein doth, but of a double one. II. Because in a Child in the Womb it performs the Office of an Artery, and Pulsates as shall be said in the next Chapter. As also in a grown person, because it carries Nutritive blood to the Lungs, which is partly wrought in the right ventricle.

Its Original and Progress. This vessel passes out of the heart with a smaller Orifice, and yet greater than the Lungs stand in need of: For *Columbus* and *Ananias* observe, that

two Fingers have been thrust thereinto; and it ought to be the greater, because it receives blood from the continual pulsation of the right side of the heart. Moreover, resting upon the Arteria Magna and inclining to the left side, it goes to the right and left parts of the Lungs with a double branch, a right and a left: Which afterward spend themselves into sundry branches in the Lungs.

Its Use is, to receive blood out of the right Ventricle, and to carry it to the Lungs for their nourishment, and according to the observations of latter Authors, to pass over the rest of the blood through the Arteria venosa into the left Ventricle of the Heart, and to hinder the blood from sliding back again into the heart.

Three VALVES are placed therein, arising from the Coat of the vein it self, looking from without inwards, and resembling an half Circle, or the letter Sigma, as it was anciently figured, and did resemble the Latine letter C.

The ARTERIA VENOSA, which others call Vena Pulmonaria, is the third Vessel of the heart, which is seen in the left Ventricle. The Arteria venosa, why an Arterie?

It is termed an Artery because of its Office: For I. It Pulsates in a grown person, because it is united to the left Ventricle, but it moves not by a proper motion of its own, because it is neither an Artery, nor doth it carry pure Arterial blood. II. It is implanted into the left Ventricle.

Tis called a VEIN, I. Because of its Substance. 2. Because in a Child in the Womb, it performs the office of a vein. And it is produced as it were from the Cava, to which it is joyned, by way of Anastomosis. Yea and in a grown person, it carries blood also to the heart, as doth the Cava.

It Arises with a round and great Orifice (greater than that of the Arteria Magna) divided into two parts presently after its egress, just in a manner as if it arose with a twofold mouth; and it is disseminated into the right and left part of the Lungs.

The Use. I. In its Dilatation to draw Air to the heart, not bare and simple Air, but mixed with the blood which returns from the Lungs, for the Generation of vital spirits and Arterial blood; and to nourish and kindle up the vital flame. For the Arteria venosa being opened in living Anatomies, doth pour blood and not pure air into the heart, which for the most part we observe thicker than ordinary in the Carcasses of Men and Beasts, because the motion of the left ventricle ceasing, the blood received in this vein, cannot be driven or drawn to the heart. And when the Arteria venosa is cut or opened, there appears no air, because the air is not pure and simple, being mixed throughout with blood. And when the Lungs of a living or dead Creature are by Art blown up, not a jot of air is perceived to come thence to the heart, because the Carriage of blood is wanting, and the natural Drawer and Driver is also wanting. But that the air such as it is, doth come into the heart, their Examples do testify, who have been stifled with the fumes of Quick-silver. Coles, Lime, &c. And otherwise the Lungs and Lung-pipes were made in vain.

II. In the Contraction of the Heart to thrust out a portion of vital blood, into the Lungs, together with

footy exhalations; which is an old opinion. But that in the Systole of the heart, blood or footy steams should be carried this way. 1. The Valves hinder, which will not suffer any thing to return. 2. The Arteria venosa being tied, doth swell towards the Lungs, and is lank and emptied near the heart. 3. Being opened it pours forth blood on this side the band, but beyond it being opened it voids neither blood nor footy exhalations. 4. The footy steams of the right Ventricle, do evaporate through the vena Arteriosa, turn into water in the Pericardium or Heart-bag, breed the hairs in the Arm-pits, and exale into the whole habit of the Body, through the Aorta. 5. The air which goes into the heart, and the footy steams which go out with the blood, should be carried the same way, in contrary motions, which is a thing unusual in the natural course observed in the body. For though ever and anon Excrements are driven from and Nutrimment is drawn to the same part, yet the way is different, especially where the afflux is continual, as in the Arteria venosa from the Lungs; or at least they are performed at different times. Therefore.

III. In the contraction of the heart, it drives blood which is superfluous after the nourishment of the Lungs, or that which runs back, out of the vena Arteriosa, into the left Ventricle of the heart.

The Mitre-shap'd Valves. TWO VALVES only are placed at the Orifice of this vessel, which look from without inwards (bred out of the Nervous circle which grows out of the substance of the heart) which being joyned together do resemble a Bishops Mitre. They are greater then the Valves of the Cava, have longer threads (and each hath seven large ones, besides little ones annexed to them, which from a broad Basis do commonly end into a sharp point) and for strengths sake very many fleshy Explantations. Therefore two were sufficient to shut the Orifice close, because they are greater then others, the Fibres longer and larger, the Columnes or Pillars stronger, and the Orifice it self is more Oval-shap'd, then that of the rest.

The Arteria Magna. THE ARTERIA MAGNA or great Artery so called, because it is the root of all others, is another vessel of the left Ventricle, from whence it proceeds and arises.

At the Orifice hereof, is placed instead of a Prop, not in Men, but in certain Beasts, as Harts, Oxen, Horses, &c. a certain hard substance, which is sometimes Gristly, sometimes Boney, according to the greatness and Age of the Beasts. In man the most noble and strongest, *Harvey* saw a portion of this Artery turned into a round bone, near the Heart, whence he concludes that the Diafole of the Arteries, is caused by the blood alone, not by any Pulsifick faculty, derived through the Membranes. Also *Johannes Schroderus* writes that the meeting together of the Arteries in the Basis of the Heart, was in an heart degenerated into a bone.

Its Use. The Use thereof is, to communicate the Vital spirit, with the Nutritive Arterial blood, received from the heart, unto all parts of the Body, for Nutrition and life; which that it may not pass back again into the heart, Three

Its Valves. Valves are placed (like those in the vena Arteriosa exactly shut) looking from without inwards, which are termed Sigmiodes or Sigma-shap'd Valves.

Chap. VIII.

How the Vessels are united in the Heart of a Child in the Womb.

THE Vessels in the heart are otherwise disposed when the Child is in the Womb, then they are after it is born; which though *Galen* knew and made mention thereof; yet the greatest part of Anatomists have either neglected the same, or have delivered falsities thereabout, by saying that the Unions of the vessels were some of them only made by a Chanel, others only by way of Anastomosis.

But the Conjunctions or UNIONS of the VESSELS of the Heart in a Child in the Womb, are twofold: *The Union of the Vessels of the Heart.*

One is made by an Anastomosis, another by a Chanel.

By Anastomosis an Union is made of the Vena Cava and the Arteria Venosa, under the right Earlet, near the Coronaria, before the Cava doth absolutely open it self into the right Ventricle. The hole is large and of an Oval Figure.

Now Nature contrived this Union by way of Anastomosis, 1. By reason of Vicinity. 2. Because of the likeness of substances.

Before this hole in the Cavity of Arteria venosa is placed a Pendulous, thin, hard, little Membrane, larger then the hole.

Its Use is, I. According to the Doctrine of *Galen* and his Clients, that the blood may be carried through this hole, out of the Cava into the Arteria venosa (not into the right ventricle, for vital spirit is not yet bred, nor do the Lungs need blood so attenuated) to nourish the Lungs; because they could not otherwise be nourished in a Child in the Womb, because in it the heart hath no motion whereby the blood might be forced out of the right ventricle into the vena Arteriosa: And therefore this Arteria venosa, is a vein in the Child in the Womb. But that it serves the turn of the Heart, and not only to nourish the Lungs, divers things Evince observed by the favorers of the Circular Motion. For 1. The Heart is moved even in an imperfect Child, after the third moneth, as Eggs and Embryo's do testify. But before the third moneth only a little Bladder of the Earlet pants, as in Insects before the Heart is perfectly hollowed. But this motion were in vain, if the Heart should not receive or expel any thing. 2. The blood by the Anastomosis is immediately poured into the left Ear, and is necessarily thence conveyed by the Systole of the Heart, into the left ventricle. 3. All the blood is carried through these Unions, doubtless not for the sake of the Lungs alone, which might be nourished after the same manner as in grown persons, although void of motion, the veins in part gaping. 4. The Child in the Womb is nourished with Arterial blood, which can come from no place but the Heart, as shall be demonstrated hereafter. Therefore,

II. The true use is, that it might convey part of the blood in a Child in the Womb, out of the Cava of the Liver, into the left ventricle of the Heart, which cannot go thither the ordinary way, the Lungs neither dilating themselves nor Respireing. In which passage the right ventricle also draws somewhat to it self.

And

The use of the little Membrane.

'Tis but after the Birth.

And that the blood may not slide back into the Cava, a little Membrane there placed hinders, when it falls in and settles.

A little while after the Birth this Hole grows together and is dried up, so that a man would think the place had never been perforated, and that by reason of the plenty of blood in a grown person, forced out of the Lungs now opened and enlarged directly to the left Earlet, which suffers not a small quantity of blood to flow out of the Anastomosis, whereupon being shut it grows together. Howbeit in grown persons, it remains for a season open. *Pineus* observed it thrice, *Riolanus* once, and myself more then once. *Borallus* most frequently in Calves, Sows, Dogs of a large size, and therefore he would have it to be alwaies and naturally open, that blood might pass this way out of the right to the left Ventricle. *Cecilius Folius* treading in his Foot-steps, thinks it is open in all Men, to the same end, as in a Child in the Womb, but contrary to experience. For it is then only open, when Nature hath shut up other passages, as I saw at *Padua* in

that old Man, whose Arteria venosa was stopped with Flegm. In Water-fowl and other Animals that live in the Water, as Ducks, Castors, Swans, Bitterns, &c. it is alwaies open, because they live now and then in the Water, without the Use of their Lungs. And I have sometimes observed in dead bodies the little Membrane winking, and receiving the Probe without any violence, but I cannot allow that it is so alwaies. And that light opening would be unprofitable. For the passage of so much blood.

Another Union is by a longish Channel, viz. that of the vena Arterialis, and the Arteria Magna, because they are distant one from another.

This Union is without the Heart (the other within the same) two Fingers from the Basis, in grown persons four, for the Channel doth not begin from the stock of the Arteria Magna. It goes obliquely to the Arteriosa (therefore no valve is annexed to it because the crookedness was able to hinder the Egrefs) (or rather because the blood is forced thither, from the right ventricle of the Heart through the vena Arteriosa but it is not in like manner driven back out of the left,

By a Channel or Pipe.

The Explication of the FIGURES.

In this TABLE are presented the Unions of the Vessels of the Heart in a Child in the Womb, also the Heart incompast with the Lungs, and the smal twigs of the Wesland or Wind-pipe call'd *Aspera Arteria*.

FIG. I.

- A. The Heart.
- B. The Ascendent Trunk of Vena Cava.
- C. The Descendent Trunk thereof.
- D. The Ascendent Trunk of Arteria Magna.
- e. The Axillary Artery.
- f. The Descendent Trunk of the great Artery.
- g. The Earlet of the right Ventricle.
- K. An Anastomosis as it appears in Vena Cava.

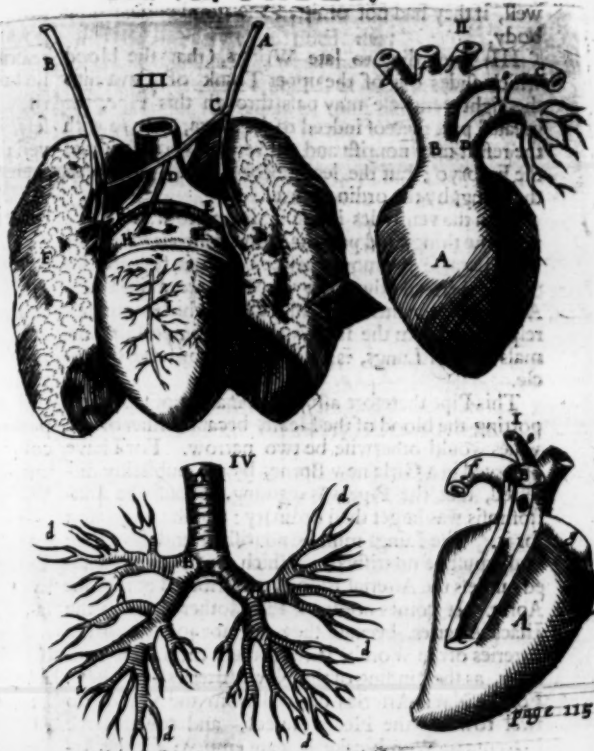
FIG. II.

- A. The little Heart of a Child in the Womb.
- B. The Trunk of the Arteria Magna, springing out of the Heart.
- C. A Portion of the said Artery going down-wards.
- D. The Vena Arteriosa drawn out of the Heart.
- ee. The Channel between the Vena Arteriosa and Arteria Magna.
- ff. The Rise of the Arteries termed Carotides or drousis Arteries.
- g. The beginning of the Subclavian right Artery.

FIG. III.

- A. The right Nerve of the sixth Pare going towards the Lungs.
- B. The same Nerve on the left side.
- C. The middle Branch between the two Nerves.
- D. The Off-spring thereof, which is carried to the Pericardium.
- EE. The two greater Branches of *Aspera Arteria*, which on the back-sides are Membranous.
- FF. The hinder part of the Lungs.
- G. The proper Membrane of the Lungs.

The VII. TABLE.



HH. A remaining portion of the Pericardium or Heart-bag.

I. The Heart in its proper place.

FIG. IV.

- A. The *Aspera Arteria* or Wesland, cut off under the Larynx.
- B. Its right Branch, divided first into two.
- C. The left Branch of the Arteria *Aspera*, distributed in like manner into greater and lesser Branches.
- ddd. The Extremities of the Branches.

by the Arteria venosa] where it is divided into two, as if it had three parts; the least whereof notwithstanding is the Channel.

In Infants of three or four years old, it is still to be seen, but without any through-dried up. passage: in grown persons tis by little and little attenuated and dried, being destitute of all Nutriment, because no Humors pass any longer through the same, until through absence of Life and Nourishment, it Putrifies and Consumes quite away.

The use thereof is, I. According to the Mind of Galen, that the vital Spirit being received from the Navil-Arteries into the Arteria Magna, may from hence be carried, through that Channel into the vena Arteriosa and so straight into the Lungs, to maintain Life. But, 1. It serves not the Lungs alone. 2. The Navil-Arteries do bring out of the Arteria Magna, but carry nothing thereinto. 3. The Pipe is greater then to serve only to carry Spirits. 4. The Lungs of a Child in the Womb being red, are not nourished only with Spirits.

II. According to Petrejus and Hofmannus, to bring Arterial blood to nourish the Lungs. Who had said well, if they had not omitted the good of the whole body.

III. According to late Writers, that the blood which slides out of the upper Trunk of Cava into the right ventricle may pass through this Pipe, the greatest part thereof indeed to the Aorta, that so with the rest it may nourish and enliven the whole body of the Embryo; but the least portion of all goes up to the Lungs by the ordinary way.

Both the ventricles in the Child perform one and the same thing, and part the blood which is to be carried, because the more perfect blood is supplied by the Mother, and therefore the Walls are a like thick. And the two ventricles in the Child which doth not respire, perform the same, which in imperfect Animals void of Lungs, is accomplished by one ventricle.

This Pipe therefore assists the Anastomosis in transporting the blood of the Heart, because either of the waies would otherwise be too narrow. For I have observed in a Girl new Borne, by me publickly dissected, that the Pipe was wanting, because the Anastomosis was larger then ordinary: and there is reason for it. The Lungs must be nourished and the whole body must be nourished. Which can never be effected, unless the Arterial Blood be distributed out of the Aorta. It comes not from the Mother through the Iliack Arteries, because they are not joyned to the Arteries of the Womb, besides their motion is contrary, as the binding of the Navil Arteries doth shew. For the Navil-Arteries derived from the Child, do swell towards the Heart thereof, and towards the Placenta or Womb-cake they are empty; for the Arterial blood in the Child, after it is nourished, runs back through the Iliack veins to the Placenta, as a part of the Child which must be nourished, out of which it passes again into the Navil-veins, and is mixed with that other blood which comes out of the veins of the Womb, and runs joyntly back again to the Liver and Heart of the Child, that the Circulation may be repeated. Now it flows conveniently out of this vena Arteriosa through the Pipe or Channel into the Aorta, by reason of its Situation downwards, and its crooked inflexion into the Aorta. Therefore seeing the Arterial blood, is not carried from the Mother,

upwards to the Heart, neither can the Lungs be nourished thereby.

Chap. IX. Touching the Lungs.

The Lungs called in Latin *Pulmones* in Greek *Pneumones* or *Pleurmones*, have their name from Respiration or drawing in and blowing out the Air: because they are given to Animals living in their Air and breathing, but not to fishes which have neither Neck nor Voice.

They are seated in the Cavity of the Breast or Chest, which they fill, when they are distended.

They are divided into the right and left part by means of the Mediastinum: that one part being hurt, the other may yet perform the Office. Each of these parts is divided into two Lobes. Laps or Scollups, about the fourth Vertebra of the Chest, of which the upper is shorter then the lower; seldom is one part divided into three Lobes, as in Bees; because a man goes bolt upright, Brutes looking downwards; nor by reason of the shortness of the Chest, could any thing lie between the Heart and the Liver, except the Midriff. Yet oftentimes Piccolbomarius, Riolanus and myself, have after Hippocrates and Ruffus Ephesus observed three. Now the Lungs embrace the Heart with their Scollups as with certain Fingers.

Their shape resembles that of an Ox-hoofe. On the outside towards the Cavity of the Chest, the Lungs are Bossie or bunched out, on the inside they are hollow, where they embrace the Heart.

Their Colour in the Child is red like that of the Liver: by reason of the nourishment is receives from its Mother; in grown persons tis yellowish Pale; sometime Ash-color'd: in such as have died of a long sickness blackish. In some persons healthy enough. I have seen them Party colored, like Marble. In that part where it is knit unto the Chest by Fibres, tis red, as in a Child in the Womb.

Tis knit in the Fore-part to the Breast-bone by the Mediastinum, behind to the Vertebra's; sometimes the Lungs at the sides grow to the Pleura by certain Fibrous bands, whence arises a lasting shortness of Breath. Now this Connexion doth frequently deceive Physicians, nor knowing or discerning Penetrating wounds of the Chest. Nicolas Massa conceives this Connexion profitable to the Heart, least it should be oppressed with the bulk of the Lungs, or the facility of breathing should be hindered, and Riolanus saies he evermore found this adhesion. I have chiefly observed it about the lower Ribs, near the Diaphragma, least they should press and bear upon it. Others say the Lungs are bound to Fibres, that in the wounds of the Chest, they might follow the motion of the Chest, though with a weaker motion. Hippocrates in his second Book

de Morbis calls it the Lungs slip down to the side; and this comes to pass either from ones Birth, or after a Pleurisie, or by reason of Tenacious and clammy flegm interposing it self, or from some external cause, as negligent Curing

The Reason of their Name.

Their Situation.

Division.

Into Lobes.

Their Figure.

Their Colour.

A certain Cause of long lasting Short-windedness.

Curing of a wounded or suppurated Chest. Also the Lungs cleave to the Heart, by the Vena arteriosa and the Arteria venosa.

The Substance. The Substance in a Child in the Womb is compact and thick; so that being cast into Water it sinks, which the Lungs of grown persons will not do. But after the Birth, because it begins to be moved with the Heart, by heat and motion the Heart becomes light and soft, lax, rare and spongy; so that the Lungs will be easily raised and fall again, and easily receive the Air: Which may be seen by the use of a Pair of bellows in dead bodies. *Helmont* hath seen the Lungs hard and stoney, in an Asthmatical person, and *Sal-muth* observes that little stones have been there generated in shortness of Breath. Also touching stones we have the Testimony of *Galen*, *Trallianus*, *Aegineta*.

Membrane. The Lungs are compassed with a thin light Membrane, furnished with many Pores which Pores are sufficiently visible, when the Lungs are blown up with a pair of bellows, and *Job. Walaeus* hath observed the said Pores in live Anatomies, as big as a large Pease. This way the Sanies or Corrupt matter of the Chest may Penetrate and come away by Coughing. This Membrane is produced from the encompassing Pleura. For when the Vessels enter into the Lungs, they devote themselves of their Coat, which grows out of the Pleura, which doth afterwards invest the Lungs.

The Vessels. The Substance of the Lungs is interwoven with three sorts of Vessels, which make not a little also for strength. Two proceed from the Heart, of which before: The Vena Arterialis and Arteria Venalis.

The third is proper, viz. The Trachea or Aspera arteria so called, of which in the following Chapter.

If these Vessels be fretted asunder as in persons *Phtisical*, or having the Consumption of the Lungs, many times plenty of blood is cast forth, or some Cartilaginous substance; yea and the Vessels themselves of the Lungs intire, which I have seen, and *Tulpius* hath two examples. And oftentimes persons in a Consumption die suddenly, because the greater Vessels being fretted asunder, the Heart is strangled with blood issuing there from.

Why the Lungs bath so great Vessels? These Vessels of the Lungs are great, not so much because they wanted much blood, for their substance is very smal, setting aside the Vessels, nor needed they so much blood as is sufficient to nourish the whole body; but they are great, because the greatest portion of the blood is carryed this way out of the right Ventricle of the Heart into the left by those wide passages, for the more subtile blood can find its way through the obscure Pores of the Septum. This passage is proved.

1. By the greatness of the vessels. For the vena arteriosa and the arteria venosa are most large. And because the former is a vessel which carries out of the Heart, it is furnished with the Mitre-fashion'd valves, which hinder the blood from passing out of the Lungs the same way; and the latter bringing blood out of the Lungs into the Heart, has the treble-pointed valves, hindring the blood from returning.

2. Great Quantity of Blood is continually sent by the Pulse of the Heart, through the vena arteriosa and thence through the arteria venosa unto the left ventricle, which is further confirmed by Ocular Inspection.

3. By Ligatures in living Anatomies. For the Vena arteriosa swells towards the Heart; but near the Lungs it is empty; the Arteria venosa contrarywise, swells towards the Lungs, but is empty towards the Heart.

See Tab. 4. of Book 2.

4. The left Ventricle of the Heart being wounded, or the Arteria aorta, great plenty of blood will issue, as long as life remains, till all the blood in the body be run out. And from what other place can it come, seeing so much is not contained in the Heart, but out of the Lungs through the Arteria venosa, which had drawn the Blood out of the Vena arteriosa by the Anastomoses.

5. In the Arteria venosa as well of a living as a dead Body, so much Blood is found, that it hath often hindered me in my publick Dissections.

6. By the similitude of the Vessels one with another. The Vena arteriosa carrying out of the Heart into the Lungs, is just like the Aorta in substance, largeness, neighbourhood, and Valves. The Arteria venosa doth in like manner resemble the Vena cava by straitness of Connexion, substance of a Vein, Earlets and treble-pointed Valves.

This Circulation through the Lungs is furthered, 1. By the widening of the Lungs when Air is drawn in, which being every where filled, the

How Circulation is caused in the Lungs.

vessels are distended, as when they cease, the motion of the Blood is either retarded, or quite ceases. 2. By the Situation of the vessels of the Lungs. The Vena arteriosa is Diffeminated in the hinder or Convex part of the Lungs, because it is strongly moved by the Pulse of the Heart, the Arteria venosa doth chiefly possess the foremore and hollow part, that the Blood might more readily slide into the Heart. In the Middlest of which the Branches of the Wind-pipe are seated, that in the blowing out of the Air, they might receive sooty Exhalations from the Vena arteriosa, and in drawing the Air in, they might communicate the same to the Arteria venosa. 3. The anastomoses, by which the vessels are joyned together, both the branches which joyn mouth to mouth (though in dead bodies they cannot be discerned by the Eye-sight) and the Pores of the Parenchyma which is light and Porous.

It is to be noted for the answering the objections made against this Circulation.

Contrary objections answered.

1. That the Lungs are not oppressed or burthened so long as they being sound, the Blood perpetually glides through by Peice-meal.

2. That the blood doth not drop out through the Pipes of the Wefand, because partly they draw in only Air or sooty Exhalations, and in no wise Blood of a thicker nature then they, unless they be preternaturally fretted in persons that have the Consumption, partly because nature never ceases to drive sound humors through the passages ordained for them, and retains what is necessary, which would otherwise go out at the passages of the Body being opened.

3. Although the Lungs of Dead bodies are whitish, yet the vessels do manifestly transpire through the external Coat. The Parenchyma it self is frequently ful, in persons strangled with blood, in others it is found emptied, because in the Pangs of Death it is forcibly excluded.

4. In burning Feavers, both the Lungs are hot, and thereupon the voice is Hoarse and dry, and they are oppressed, as appeared in the Epidemical Feaver

L I which

which rag'd up and down this year, by which many were strangled.

5. It is no good judging of the healthy state of the Body, from the preternatural state thereof.

Why Ulcers of the Lungs are without pain. Very small *Nervoules* from the sixth Pare are spread only through the Membrane thereof (which if it be inflamed, a pain will be felt, and communicated to the side it self and to the Back) not through the substance of the Lungs, least by Reason of their continual motion they should be pained. Hence the Ulcers of the Lungs are without pain. Howbeit *Riolanus* allots very many Nerves to the substance of the Lungs also, drawn from the Implication and Contexture of the Stomach Nerves. I also have seen many spread abroad within the Lungs, proceeding from the sixth Pare, and always in a manner accompanying the Bronchia or Lung-pipes, derived from the hinder part, and only a little twig convey'd to the Membrane from the forepart.

What the *Action* of the Lungs is, Authors Question. That they never move at all is *Helmonts* Paradox, but serve only as a sieve, that the Air may pass pure into the Chest, and that the Muscles of the Belly alone do suffice for Respiration. But

Whence the motion of the Lungs proceeds.

that they are indeed and in truth moved, the cutting up of live bodies shews, and Wounds of the Chest, that they move long and strongly. Moreover that they may be moved, any one may try with a pair of Bellows. Finally, They ought to be moved, for otherwise both the Heart would be suffocated, and the motion of the blood in the Lungs, would be hindered. The Muscles of the Belly do indeed concur, but secondarily, because they are not joyned to the Heart, and when they are moved Respiration may be stopped, Yea, and when they are cut off in a living Anatomy, the Lungs are moved nevertheless. But whether they are moved by their own proper force, or by some other thing, is a further Question. *Averrhoes* who is followed among the late writers by *John Daniel Horstius*, conceives the Lungs are moved by their own proper force, not following the motion of the Chest, for otherwise saies he we must grant that a violent motion may be perpetual.

But we are to hold, that though the Lungs are the Vessel of Respiration, yet they are so not by doing, but by suffering. For they have no motive force of their own, as *Averrhoes* will have it (because at our pleasure we can stop our breathing, or quicken or retard the same) nor do they receive the principle of their motion from the Heart, or from the blood raising them, as *Aristotle* conceives, and his

Aristotles Error.

followers, For 1. The efflux of the blood out of the Heart, is made by the ordinary motion, but the Respiration is voluntary. 2. The Cause of the Pulse and Respiration would be one and the same, and they would be performed at one and the same time. But thirty Pulses answer one Respiration. 3. While we draw in our Breath strongly, and hold the air drawn in for a season, the swelling of the Lungs should compel us to let our breath go, because it lifts up the Chest, according to their opinion. 4. The Blood of the Heart doth not abide in the Lungs by an unequal retention, so as to distend them, but it is forthwith expelled according to nature. 5. When it tarries longest in diseased Lungs, it makes shortness of Breath or difficulty in breathing, but no Tumor. 6. In a strong Apo-

plexy, the motion of the Lungs ceases, the Pulse being safe and the Heart unhurt.

Nor are the Lungs raised up, by the air forced in, which when the Chest is lifted up, because it hath no other space whither it can go to, it is carried through the *Aspera arteria* or Wefand into the Lungs, as *Falcobergius* and *Des Cartes* conceive, and *Hegelandius*, *Regius*, and *Prateus* who follow him: For 1. The air may easily be condensed, as may be proved by a thousand experiments, as by Cupping-glasses, Weather-glasses, Whips, Trumpets, Winds and infinite things beside; and therefore it may be most straitly compacted about the Chest, and compressed within it self, as well by the internal subtile nature of the air and dispersed by Atomes, easily recollected one within another, as by the external impulse of the Chest, whereby it may more easily be condensed, then driven into another place. 2. By the motion of the Chest or such a like body, we do not see the lightest thing that is, Agitated. By an hole in a Wall all Chinks and Dores being closely stopped, our Nostrils being stopped, we may with our Mouths draw air out of the next Chamber, to which it is not credible that the air moved by the Chest, can reach with a strong motion; and though air may penetrate into the Chamber, through some chinks and Riffs, yet is it not in so great quantity, as to stretch the Chest so much as it ought to be stretched, in free Respiration. The same experiment may be made in a Glass or Silver vessel applied close to ones Mouth. 4. While I have held my Breath, I have observed my Belly to be moved above twenty times the while. But whether is the Air then driven? Must it not needs be, because all places are full of bodies, that the air next the Belly is compressed and condensed? See more of this subject in my *Vindicia Anatomica*, and in a peculiar *Discourse*.

Therefore the Lungs do only follow the motion of the Chest to avoid *Vacuum*: And therefore only they receive the air drawn in, because the Chest by widening it self, fills the Lungs with air.

Now that the Motion of the Lungs arises from the Chest experience shews. For 1. If air enter into the Chest, being pierced through with a Wound, the Lungs remain immovable, because they cannot follow the widening of the Chest, the air insinuating it self through the wound, into the empty space. But the Chest being sound, the Lungs follow the widening thereof, to avoid *Vacuum*: as in Pipes, Water is drawn upwards, and Quittor, Bullets, Darts and other hard things are drawn out of body through the avoidance of *Vacuum*. 2. If the Midriff of a live Creature be pierced through with a light wound, Respiration is stopped, the Chest falling in.

But somewhat there is which hinders many worthy men from assenting to this cause of the Lungs motion, because after the Chest is perfectly opened, the Lungs are oftentimes moved a long time, with a vehement motion. But according to the Observation of *Johannes Waleus*, *Franciscus Sylvius*, and *Franciscus Vander Shagen*, that is not the motion of Constriction and Dilation, which is the natural motion of the Lungs; but it is the motion of an whole Lobe upwards and downwards, which motion happens, because the Lungs are fasten'd to the Mediastinum, the Mediastinum to the Midriff, and the Lungs are also

The Opinion of Falcobergius.

The motion of the Lungs is proved to arise from the Chest.

An Observation in live Anatomies.

scared

seated near the Midriff : whence it happens, while the Creature continues yet strong, that either the Lungs with the Mediastinum are drawn, or by the Midriff driven, the Diaphragma or Midriff, not yet falling down nor loosing its motion, which I observe in contradiction to the most learned Son of *Horstius*. Now that this motion proceeds not from the inbred force of the Lungs, doth hence appear, in that alwaies when the Chest is depressed, the Lungs are lifted up, being forced by the Midriff, which at that time rises a good height into the Chest ; and contrarywise the Chest being lifted up, the Lungs are depressed. And because the Lungs are the Instrument of Respiration, Hence it hath these following,

Its Use. I. According to *Plato*, *Galen*, and *Abensime*, to be a soft Pillow and Cushion under the Heart.

II. According to others who follow *Columbus*. to prepare and wellnigh generate the vital Spirits (which are afterwards to receive their perfection in the heart) whiles in them the blood is as it were Circulated, first boyling with the heat of the Heart, and afterwards settled by the coldness of the air.

III. It hath more proper uses when it is Dilated, and when it is contracted.

When the Lungs are Dilated, they receive in the Air like a pair of Bellows through the Branches of the Wind-pipe.

I. To prepare Aire for the Heart, for the convenient nourishment of the lightful Spirit. For every quality of the Aire is not a friend to our Spirit, as is seen in such, as are kild with the smoak of Charcole, and the steam of newly whited Walls.

Helmont conceives that the Air is united to the Spirit of the Heart, and that it receives a fermentation in the Heart, which accompanying the same they do both dispose the Blood to a total transpiration of it self, which is the reason why in the extremity of cold weather and at Sea, we eat more heartily, because the thinness of the Air disposes the blood to insensible transpiration. *Backius* is somewhat of the same mind, who conceives that by the moist and thin body of the Air, the blood is made apt to run, so that it may be diffused into the smallest passages of the Body. Others ascribe both these effects to the abundance of Serosity in the Blood. Therefore *Hippocrates* saies that water is hungry ; and we see that such as are given to drink, are enclined to sweat much, as also *Scorbuck* persons.

II. To fan and cool the heat. For we see that the heat of our Bodies stands in need of somewhat that is cold, without which it is extinguished, as is apparent in such as stay long in very hot Baths, as the flame of a Candle in a close place, wanting Air goes out. And therefore the Lungs are called the Fan and cooler of the Heart, and the Fishes in the Water and other Animals that have but on Ventricle in their Hearts, are without Lungs, because they do not want such a cooling. As also Infants in the Womb, being fanned by their Mother, and the wide Anaestomoses, have their Lungs without motion. Hence it is that having seen only the Lungs, you may judg how hot any Creature is ; for Nature makes the Lungs the larger, by how much the

Heart is hotter. Therefore the Lungs are not absolutely necessary to Life, but serve to accommodate the Heart. For instead of Lungs a boy of *Amsterdam* four years old, had a little Bladder full of a Membranous wind, as *Nicolas Fontanus* a Physitian of that City doth testifie, which being guarded with very final Veins, had its original from the Aspera Arteria or Wesand it self, whose office it is to cool the Heart. Who nevertheless died of a Consumption, because haply, his Heart was not furnished with a sufficient quantity of Air.

When, the Lungs are contracted in Expiration, they do again afford us a twofold use. I. Sooty Excrements do pass away through the same, being carried out of the Heart with the blood, through the Vena Arteriosa. II. To make an articulate voice in Men, and an inarticulate sound in Beasts, by affording Air to frame the voice. And therefore Creatures that have no Lungs, are mute, according to *Aristotle*.

Chap. X. Of the Lung-Pipe or Wesand.

The Pipe or Channel of the Lungs, is by the Ancients called *Arteria*, because it contains Air ; *Galen* and others call it *Trachea arteria* or the rough Artery, because of its unevenness, and to difference it from the smooth Arteries. *Laurentius* terms it *Spiritalis Fistula*, the Spirit or Air-Pipe, because the Air is breathed in and out thereby. Now it is a Pipe or Channel entring into the lower part of the Lungs, with many branches, which are by *Hippocrates* termed *Syringa* and *Aorta*, whose head is termed *Larynx*, of which in the following Chapter ; the rest of its Body is termed *Bronchus*, because it is moistened with drink. For that some part of the drink doth pass even into the Wind-pipe and Lungs, *Hippocrates* doth rightly prove by an Hog new kild, in whose Lungs matter is found just so colored as the drink was, which he drunk immediately before he was killed. And that some drink may be carried through the Wind-pipe, may be proved out of *Julius Japsolinus* an Anatomist of Naples, who seeking in the body of a Noble person, the Cause of his death, found his Pericardium or Heart-bag, so distended with Humor, that it being squeezed, some of the said Humor came out at his mouth.

As to its Situation : in Man-kind it rests upon the Gullet, for it goes down from the mouth straight along to the Lungs : and at the fourth Vertebra of the Chest, it is divided into two branches, each of which goes into the Lungs of its respective side : they are again subdivided into two other branches, and these again into others till at last they end into very small twigs in the surface of the Lungs. But the branches thereof which are greater then the rest of the Vessels of the Lungs, entring into the Lungs, do go through the middle thereof, between the Vena Arteriosa which is hindered, and the Arteria venosa which is before it : with which it is joyned by obscure Anaestomoses, or conjunctions of Mouths, hardly discernable by our Eye-sight.

In Bruits its Situation much after the same manner.

The Wesand.

Why call'd Trachea or Aspera Arteria ?

Whether any part of our drink doth pass into the Wesand and Lungs.

Its Situation in Man-kind.

Our heat doth want a Cooler.

Why Fishes need no Lungs.

The Lungs of Children in the Womb move not.

Lungs, you may judg how hot any Creature is ; for Nature makes the Lungs the larger, by how much the

manner. Yet we must note that it is different in a Swan, and after a manner altogether singular. For being longer, it insinuates it self by a crooked winding into a case of the Breast-bone, and soon after from the bottom of the case, it returns upwards, and having mounted the Channel-bones, it bends it self towards the Chest. But before it reaches the Lungs, it is propped by a certain boney Pipe, broad above, narrow beneath, which in a Duck is round, then it is divided into two branches, which swell in the middle, but grow smaller where they tend to the Lungs, till they enter into them.

It is clothed with a double Membrane: one External, another Internal.

The External is a thin one arising from the Pleura, and sticks close to the intermediate Ligaments of the Gristles, and Ussers along the recurrent Nerves.

The Internal being furnished with straight Fibres is thicker and more solid (most of all in the Larynx, least of all in the branches of the Lungs, indifferently in the middle Pipe) to the end it may not easily be hurt by Acrimonious drinks, or other Liquors voided by Coughing, or falling down from the Head.

It arises from the Coat which compasses the Palate, and therefore is continued with the Mouth.

It is smeared with a fat Humor to hinder its being dried up by motions, loud cryings, drawing in of hot Air, going out of sharp footy Exhalations, &c. And by the Superabundance or Deficiency hereof the

The Voice hurt.

Voice is hurt. For in the former contracted by Distillations, it becomes Hoarse; in the latter through burning Feavers, &c. It becomes squeaking. If it overabound, we are quite Dumb and unable to speak, and the moisture being consumed our Speech returns again: which might happen in that same dumb Son of Cræsus mentioned by Herodotus, and in Ægle a Samian wrastler, mentioned by Valerius Maximus, and Zaccbarias Orphanus a Fool, of whom Nicolas Fontanus tells a story in his Observations.

This Coat is of exquisite sense, that it may raise it self to expel what ever is trouble-some thereunto.

Between these two Membranes is the proper substance of the Trachea arteria, which is partly of the nature of a Gristle, and partly of a Ligament.

The FIGURES Explained.

This TABLE represents the Aspera Arteria, the Oesophagus, the recurrent Nerves about the Arteria Magna and the Arteria Axillaris, behind

FIG. I.

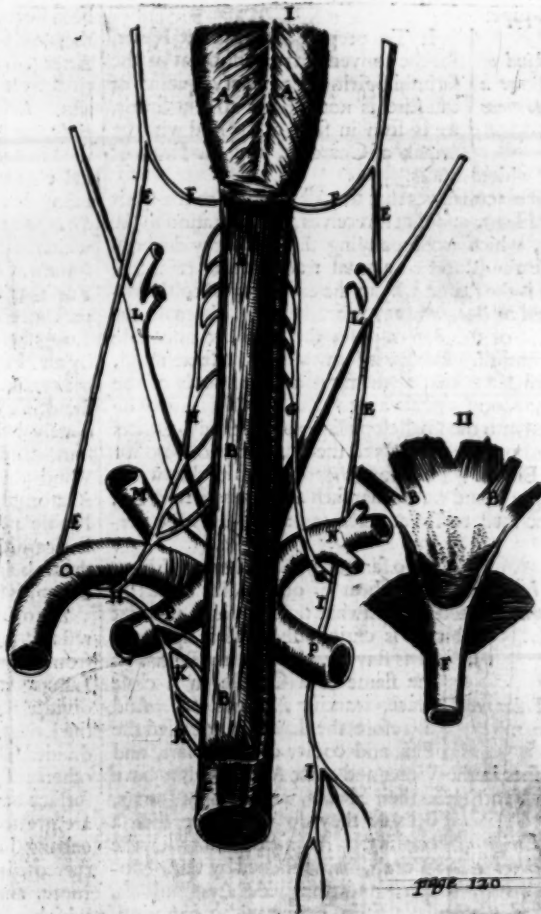
- AA. The Muscle contracting the Oesophagus.
- BBB. The Oesophagus or Gullet.
- CCC. The Aspera arteria or Wind placed under the Throate.
- D. The Membrane between the Wind and the Gullet.
- EEEE. The Nerves of the sixth Conjugation.
- FF. Nerves of the Tongue inserted behind.
- GG. The right recurrent Nerve, turned back to the Artery of the Shoulder.
- HH. The left recurrent Nerve about the Descendent Trunk of the Arteria Magna.
- II. A Nerve tending to the left Orifice of the Stomach and to the Diaphragma.
- KK. A Nerve descending to the Diaphragma.
- L. The jugular Arteries on each side one.
- M. The left humeral Artery.
- N. The right Humeral or Shoulder Artery.
- OO. The Arteria Magna or great Artery.
- PP. The Trunk of the Arteries descending to the Lungs.

FIG. II.

This Figure shews the upper part of the Gullet with its Muscles.

- AA. The Musculi Cephalo-pharyngæi so called.
- BB. The Musculi Spheno-pharyngæi.
- CC. The Musculi Stylopharyngæi.
- DD. The Schneiderian arm from the Gullet.
- E. The Inside of the Gullet.
- F. The Descending part of the Gullet.

The VIII. TABLE.



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Why the We-
find is in part
Griffly?

I. For the Voices sake: because that which makes a sound must be solid.

would not easily be opened in Respiration.

Why in
part Liga-
mental.

It was to be partly *Ligamental*, and not wholly of a Griffly substance: for if it should consist of one only Griffly, or many circular ones,

I. It would be evermore open, and not sometimes widen and then fall together.

II. It would bear hard upon the Gullet, to which nevertheless, it ought to give way, especially in the swallowing down of solid meats, that the Throat or Gullet might be sufficiently widged. And so the Griffles help to frame the Voice; and the Membranous Ligaments for Respiration.

The *Griffles* are many, round like Rings, but not exactly. For on their backside, where they touch the Gullet, a fourth part of a circle is wanting, in place whereof there is a Membranous substance.

From their shape they are termed *Signa-bus* resembling the old Greek letter C, til they are fixed in the Lungs, for then changing their Figure, they change their name. For the Wind-Pipes do there consist of perfect Griffles, Round, four square, or Triangular, but where they are joyned to the rest of the Vessels of the Lungs they become Membranous.

These Griffles are joyned together by Ligaments going between, which in Men are more fleshy, in brute Beasts more Membranous; and in men the shew like little Muscles. And the Griffles do every where keep an equal distance from one another, and the higher, the greater they are.

It hath Vessels common with others. *Veins* from the external Jugulars; *Arteries* from the Carotides; Nerves, from the Recurrent Nerves of the sixth pair.

The Use of
the Wefand.

Its Use is, I. In drawing in the Air, that by it as a Pipe, the Air may be received from the Lungs, as from a pair of Bellows. Hence comes that same

Wheezing in such as have the Tiffick, the Pipes of the Wefand being stopped, so that the Air coming and going and not finding a free passage makes that Hissing noise.

II. In blowing the Air out, 1. That through it Fuliginous Excrements may be voided at the Mouth and Nostrils. For which intent the mouths of the *Vena arteriosa* do so artificially joyn with the Mouths of the *Aspera arteria*, that there is passage only for sooty steams but not for blood, unless it come away by force and violent Coughing. In the next place, that it may help to form the voice, which it doth by expiration likewise, though some Juglers frame their Voice by inspiration only or drawing in of their Breath. And therefore *Hippocrates* calls it the breathing and vocal Organ. A wonder therefore it is that some Men can live long in the Water like Fishes, by Nature and not by Art, if *Cardan* is to be believed in the second Book de *Subtilitate*, when he makes relation of one *Calanus* a Diver in *Sicily*, who would lie three or four hours under the Water. And how in the *West-indies* everywhere, such as dive for Pearl-oysters, will lie an hour together under the Water. If they did this by some art, it were not so wonderful. So the *Egyptians* are most perfect divers, and exercise Robberies that way. For as appears by the

Description of *Nicolas Christophori Radzivily* his journey to *Hierusalem*, they lie lurking under the Waters, and not being content to steal on land, what ever they can catch they draw into the water, and carry it away: and frequently they catch a man as he lies upon a Ships deck draw him under the water and kill and strip him of his cloathes: So that such as sail are said many times to watch all night armed. And in the same parts, abundance of fisher men will dive under the water and catch fish with their hands, and they will come up with a fish in each Hand and a third in their mouths. These persons doubtless, do either live only by Transpiration, as such do that have fits of the Apoplexy and the Mother; or they have Anatomoses open in their Hearts, by means of which as in the Womb, the blood is freely moved, without any motion of the Lungs.

Chap. XI. Of the Larynx.

THE Head or beginning of this The Larynx.
Lung-Pipe, is termed LARYNX, which is the voices Organ.

Its Situation in the Neck, and that in the middle thereof, for it is

In Number one, that there may be only one voice.

Its Figure is round and almost circular; because it was to be hollow for the voices sake; but on the fore side it is more Extuberant, on the hinder side depressed, that it may give way to the Gullet, especially in the time of swallowing, in which while the *Oesophagus* is depressed, the Larynx runs back upwards, and so assists the swallowing, both by giving way and bearing down that which is to be swallowed.

Its Magnitude varies according to the Ages of persons. For in younger persons the Larynx is strait which makes their voice shril: in grown persons tis wider, and therefore their voice is bigger. To which also the length or shortness of the Larynx doth contribute: and if plenty of Air or Spirit be drawn and expelled, the Voice becomes big; if little, it becomes small.

And therefore according to *Galen* there are two causes of a great Voice: the Largeness of the *Aspera arteria*, and the strong blowing out of the air, and *Hippocrates* saies both these are caused by great heat. And therefore in his Book of the Seed, he teaches us that the stones do contribute to the formation of the Voice, Hence Males when they grow of ripe years change their voice. A Guelled Horse looses his neighing. A Capon leaves his crowing or crows after a weaker fashion, different from his former crowing.

The Parts of the Larynx or about the Larynx: are Griffles, Muscles, Membranes, Vessels and Kernels.

Its Muscles do first of all offer themselves, which move the Griffles, which the Larynx is posselt of, that it may be moved with a voluntary motion, seeing we utter our Speech, as we please our selves.

Now the Muscles of a Mans Larynx, are but thir- teen, four common and nine proper: though some make twenty, other eighteen, others fourteen.

M m

The

The FIGURES Explained.

This TABLE Represents the Larynx, with its Muscles and Gristles.

FIG. I.

- A. The Gristle call'd Shyroides or Scutiformis, Sheild-fashioned.
 BBBB. A Pair of common Muscles called Sternothyroides.
 CC. Another pair of common Muscles called Hyothyroides.

FIG. II.

- A. The Epiglottis lying yet hid under the Scutiformis.
 B. The Scutiformis or Sheild-fashioned Gristle.
 CC. Its Procefs.
 DD. Two Muscles proper to the Larynx, of which that on the left Hand is removed from its place, that the Ring-fashioned Gristle E. may be seen.
 F. The Extruberancy of the Ring-fashioned Gristle, or Cartilago Annularis.
 G. A portion of the Aspera Arteria.

FIG. III.

- AAA. The Bone Hyoides with three Extruberancies.
 B. The Epiglottis.
 CC. The Sheild-fashioned Gristle, hollow on the Back-side.
 DD. The two Muscles call'd Cucullares, or the hinder pair of the Cricothyrenoides so called.
 E. The hinder and Membranous part of the Aspera Arteria.
 FF. The Muscles call'd Arytenoides, by some the ninth pair.

FIG. IV.

- A. The Concave part of Cartilago Scutiformis dilated.
 B. The third pair of proper Muscles call'd Cricothyrenoides laterale.
 C. The first pair of proper Muscles.
 D. The fourth pair call'd Thyroarythenoides internum.
 EE. Infection of the recurrent Nerve.
 FF. The hinder and Membranous part of the Aspera Arteria.

The IX. TABLE.

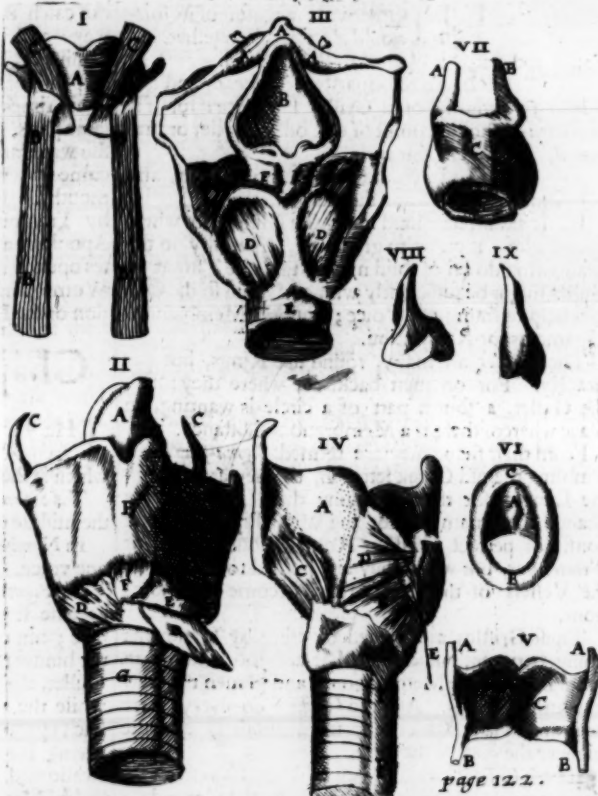


FIG. V.

- AA. The Cartilago Thyroides or Scutiformis.
 BB. The inferior procefses thereof.
 C. Its Concave Part.

FIG. VI.

- A. The inside of the Cartilago Annularis.
 B. Its lower and fore-side.
 C. Its hinder and upper-side.

FIG. VII.

- A. B. The Cartilago Aryténoides according to its hinder side joyned, as yet to the Annularis.
 C. The broader and Back-part of the Annularis.

FIG. VIII. IX.

Shews the Gristles which constitute the Aryténoides, Separate from the Annularis.

The Common. The Common are those which are implanted into the Larynx, and yet do not arise therefrom.

The Proper.

The Proper have both their original and termination in the Larynx.

The first pair of the common, called by the Ancient Sternothyroides, being lower more, arises within from the Breast-bone, its original being broad and fleshy, and going a long by the Wezand, it is inserted beneath into the sides of the Sheild-fashioned Gristle.

Its Use is to straiten the Chink of the Larynx, by drawing down the Scutiformis.

The second Pair called Hyothyroides, being the uppermore, arises from the lower side of the Os hyoides, being broad and fleshy, and touches the Scutiformis, being implanted into the Basis of the said Scutiformis.

Its Use is to widen the Chink, by lifting up the Scutiformis.

Spigelius and Veslingius assign contrary offices to these: for they will have the first pair to widen and the second to straiten the Chink of the Larynx.

Others do here add a third pair, which Columbus nevertheless and Casserius do account but one Muscle.

But

But this is rather *Musculus Deglutitorius*, or a Swallowing muscle, because arising from the Scutiformis tis wrapped about the Gullet.

It is judged, by contracting the sides of the Scutiformis, to straiten the Chink: but it is no Servant to the Larynx unless by accident.

The first proper Pair, arises on the fore-side, from the lowest part of the Scutiformis, as the Insertion of the Nerves doth shew, and ends at the *Annularis*. And therefore this pair may be termed *Thyrocricoides*; but not, as most Anatomists will have it, *Cricothyroides*. Some will have it to arise from the fore-side of the *Cricoides*, and to end into the lowest side of the Scutiformis. If it be broad and spread out side-ways, it may be divided into two pair, the *foremore* and the *side pair*, and so *Riolanus* divides it. But it is for the most part single and small enough.

Its Use is to draw the *Cartilago Annularis* to the Scutiformis (lightly, because it is almost immoveable) so that they may be joyned together, and kept in that posture. Others who differ about its original, will have it to widen the Chink or the Scutiformis.

The second Pair rises from the back side of the *Annularis*, with a fleshy original, and is implanted into the lower part of the *Guttalis* or *Arytenoides*, with a Nervous end, opening the Larynx, by drawing asunder the two Gristles called *Arytenoides*. And therefore they are called *Par Cricothyrenoides posticum*. *Casseri* calls them *Par Cucullare*.

The third pair, *Cricothyrenoides laterale*, arises above from the sides of the *Annularis*, and is inserted at the sides of the *Guttalis*, into the joyn, there where it is not touched by the former, and opens the Larynx, with the same oblique carriage of the Gristles.

The fourth pair, called *Thyroarytenoides*, being inward and very broad, proceeds from the Scutiformis, viz. from its inner and fore part, and from the *Cricoides* likewise, as *Riolanus* suspects, and ends into the sides of the *Guttalis*, or the *Arytenoides*, which while it contracts and draws to the *Thyroides*, it shuts the Larynx, by a straight passage. When this pair is inflamed in a Squinzie, it makes the Disease deadly, because it exactly shuts the Chink.

The ninth Muscle, which others term *Quintum par Arytenoides*, arises from the hinder line of the *Guttalis*, and being carried along with transverse Fibres, it is inserted into the sides thereof, shutting the Larynx, while it straitens the *Cartilago Arytenoides*.

For it is to be noted, that all the proper Muscles of the Larynx, are ordained either to contract or widen the Chink, which that it may be the more conveniently accomplished, some of them widen and straiten the *Thyroides*, others the *Arytenoides*, which Gristles do compass the Chink, which being drawn in, or widened, the Chink is withal made narrower or wider. Whence it appears, that I have not unskillfully propounded the Muscles of the Larynx, as *Riolanus* upbraides me.

The *Epiglottis* in Mankind has no Muscle; for it is not voluntarily moved in Men, as some vainly persuade themselves; but is only depressed by the weight of such things as are swallowed.

But in brute Beasts, the *Epiglottis* hath Muscles, because they are continually eating, and chewing the Cud, and they have a very great *Epiglottis*. And in them some Muscles arise from the *Hyoides*, and are implanted into the Basis of the *Epiglottis*, which they lift up; (and this pair *Vesalius* reckons to be the fifth

common pair) and others are seated between the Coat of the *Epiglottis* and the Cartilage, shutting the same.

The Gristles of the Larynx are five: } Its Gristles, which in elderly persons do sometimes attain a boney hardness; by means whereof, some have escaped the danger of suffocation, when they hung upon the Gallows.

The first Gristle is termed *Cartilago Thyroides*, or *Scutiformis*, *Scutalis*, *Clypealis*, *Peltalis*, &c. from its shape; because it resembles a shield, being in a manner four-square, hollow within, Boiste and bunching without, but more in Men than in Women: because their Necks are made even, for beauties sake, by those

Kernels placed by the Larynx. That same bunch which is seen on the fore-side of the Neck, is called *Adams Apple*, because the common people have a beleife, that by the judgment of God, a part of that fatal Apple, abode sticking in *Adams* Throat, and is so communicated to his posterity. It is distinguished in the middle with a line, and therefore some have made it double, whereas in truth it is very rarely found otherwise then single.

In its Corners it hath processes, above two long ones, wherewith by help of a Ligament, it is joyned to the lower sides of *Osthyoides*; and beneath two likewise, by which tis joyned to the following Gristle.

The second is the *Cricoides* or *Annularis*, because it is round like a Ring, and compasses the whole Larynx. Now it resembles the Turkes Ring, wherewith they Arm their Thumbs when they shoo; for the hinder part is broad and very thick. The fore part is straiter and drawn in like one of our Rings. Tis vulgarly termed *Inuominata*, or the nameless Gristle, because the ancients gave it no name. Tis the Basis of the rest of the Gristles, by help whereof they are joyned to the *Aspera Artera*, and therefore it is immoveable.

The third and fourth, which others count for one, when the Membrane is taken off, appears to be double. Tis called *Arytenoides*, *Guttalis*, by reason of its resembling the spout of an Ewer, whereout the Water is poured, if the two processes of the upper part are considered, which being joyned together do make up that little Chink which modulates the voice, which others terme *Lingula*, *Parva Lingua*, or *Glottis*, the little Tongue, for the voice cannot be framed but through a narrow passage. This rests upon the upper and hinder side of the *Cricoides*, in the Cavity of the *Thyroides*.

In this place is to be observed a certain Hollownesse, which is formed between the *Guttalis* and the *Scutalis*, by the Membranes which gather up the Cartilages; into which if peradventure while one is speaking or laughing, and the *Epiglottis* is open, a crum of bread or a drop of drink do happen to fall, it causes Coughing, because it goes against the Course of the wind. But if any thing slide leasurely down the Chink, by the Walls of the Larynx, it hinders not the wind, and so causes no Coughing.

The fifth is termed *Epiglottis*, which covers and shuts the Chink, least an considerable quantity of meat or drink should fall into the Weland, but that the *Epiglottis* being shut, they might pass down the Gullet. But it is not exactly shut, so that some final quantity of drink may slip down the sides. For when we say that drink passes not

Adams Apple is more bunching out in Men then in Women.

The Glottis.

Epiglottis.

not into the Wefand and the Lungs, it is to be understood of the greateft part; for that fome is carried thither, I have fhewed you before. And therefore in Difeaſes of the Cheft, we preſcribe Eleſtuaries and Lozenges, which are to be held in the patients mouth, his Head leaning backwards, till they melt away, that ſome portion of them may ſlip in by the Walls of the Wefand. Tis opened when we Laugh, and therefore Men muſt be careful that they do not Laugh when they are ſupping of broath, or the like. Alſo let ſuch as are greedy eaters take heed leaſt, any meat get between the *Epiglottis* and the Chink, whence immediately ſuffocation follows, as I have ſeen in a yong man of *Hafnia*, who was ſuddenly choaked by a peice of Neats-tongue weighing an ounce and an half, greedily eaten.

Now the *Subſtance* of the *Epiglottis* is ſoft, and its *Shape* reſembles a Tongue, or an Ivie leaf, according to *Hippocrates*. And on either ſide a *Membrane* is faſtend to the common mouth; ſuch an one as that which being daubed with a clammy Humor, doth compaſs the inner Cavity of the *Larynx*, and the outſide thereof is likewiſe covered thereby.

As for *Veffels*.

Veffels | The *Larynx* hath *Veins* from the internal Jugular.

It hath *Arteries* from the larger branch of the *Carotides*.

It hath *Nerves* which *Galen* terms *Vocales*, for the motion of the Muſcles, from the recurrent branch of the fixt pair.

Two parcels of *Kernels* attend the *Kernels*. | ſame.

One *Parcel* at the upper part of the *Larynx*, viz. at the ſides of the *Uvula* or the *Gargareon* which are called *Tonſilla* or *Amygdalæ*, alſo *Parithima* and *Antiaides* the Almonds of the Ears: which being Spongy (on each ſide one) do receive the moiſture of the Brain, turn it into Spittle and therewith moiſten the Throat, *Larynx*, Tongue and *Oeſophagus*; though it helps alſo our Taſting, which cannot be performed without moiſture. Theſe *Kernels* are about the Root of the Tongue, and are covered with the common Coat of the Mouth, and receive *Veins* from the Jugulars.

They have placed by them two little white *Bladder-keys*, which receive ſerofity out of the *Kernels*, and void forth into the Mouth. *Riolanus* doth acknowledge no ſuch in a Man, but Subſtitutes in their ſtead *Ligamentar Membranes*, ſtretched out from the *Uvula* to the Almonds.

Others ſtand by the lowerſide of the *Larynx*, on each ſide one, at the ſides of *Cricoides* and of the firſt ring of the Wefand, being great and ſpongy, through which *Veins* are ſpred, from the *Jugularis externa*. In Women it is more Perſpicuous; in a Ma and in an Ox, more fleſhy and red.

The *Uſe* is, to bedew the *Larynx*, with a clammy and fat, but not fluid moiſture, that the *Griſtles* may be more fit for motion, and the voice may be made ſweeter: which is imitated by thoſe who anoint their pipes with Oyl.

The *Uſe* of the *Larynx* is to be the Organ of the Voice.

For the *Organs* of the Voice are either *Remote* or *Immediate*.

The *Remote* are the Cheſt and the Lungs, without the Aſſiſtance of the Heart; for if the four *Veffels* of the Heart ſhould be tied, and the Heart cut off, yet a

Dog can both run and bark, as beſides later Authors, *Galen* did often experiment: and the illuſtrious *Sr. Francis Bacon*, in his *Hiſtory of Life and Death*, *Article 15*. tells of an unbowelled Man, who after his Heart was taken out, uttered three or four words of his Prayers.

The *Immediate* are either preparatory, as the *Trachea*; or aſſiſtant as the *Muſcles* and *Nerves*; or conſervatory, as the *Mouth* and *Throat*. But the moſt principal part is the *Larynx*: and that part thereof termed *Glottis* is the next and adequate Organ of the Voice.

Now the Voice is made after this manner: the Air is ſuddenly and strongly blown out by the Lungs, and the Chink is moderately ſtrained, where by the ſmiting of the Air the Voice is made, as we perceive the wind to whistle through the Chink of a Dore. And therefore *Ariſtotle* calls the Voice a ſmiting of the Air; underſtanding, in a cauſal way of expreſſion, the Action for the quality ſpringing therefrom. And if the breath go out, the Organ being wide open, it cauſes a *Sigh*.

And therefore, that noiſe which Animals make cannot properly be termed a voice, they wanting this Organ; as the noiſe which ſome fiſhes make, the croaking of Frogs, and the creaking of Graſs-hoppers. *Ariſtotle* tells us that the croaking of a Frog is made, when the Lip of the lower Jaw being equally let down, and a little water being in their Throats the upper Jaw which remains immoveable, is ſo forcibly bent, that their Eyes ſeem to ſparkle. But, it is evident, that a Frog hath Lungs, and a Chink in ſtead of a *Larynx*. And therefore the Voice is an Animal ſound, made by the *Glottis* through ſmiting the Air as it is breathed in and out, being produced to ſignifie the Conceptions of the Mind. And therefore Voice is only in living Creatures, nor is every ſound in them a Voice, but that which is made in the *Glottis*; not Coughing, nor hawking. If any Fiſhes make a noiſe, it is by their Gills or ſome ſuch thing, but not by their Mouths. Creatures without Blood and Inſects, as Bees, Waſpes, Locuſts and the like, utter no Voice, but as *Ariſtotle* rightly obſerves in his fourth Book de *Hiſtoria Animalium*, they make a noiſe which proceeds from their Back, as for example ſake, a Graſs-hopper makes a noiſe, by rubbing its wings one againſt another; For in theſe inſects there is contained a certain Spirit and Air, in a Membrane beneath the *Septum Tranſverſum*. Others will have it that inſects make ſuch noiſes by bearing the Air after ſundry manners with their wings.

The *Differences* of Voices are infinite, which are made, 1. By the Figurati-
on of the Mouth. 2. By the different Percuſſion and Modulation of the Air, as we ſee in Pipes. 3. From the largeneſs and other qualities of the Inſtruments, viz. the *Larynx*, Wefand, Lungs and Cheſt. 4. According as the Voice comes to the Ear, intire or mangled. And beſides theſe differences, every particular Beaſt hath a voice of its own, which the Brutes themſelves can accurately diſtinguiſh, having herein a better hearing then Men. For a Lamb newly brought forth, knows its Mothers bleating among a thouſand Sheep, and the Ew likewiſe knows the bleating of her own Lamb from all others. Which is alſo true of Hens and Chickens. For the ſame voice never happens, becauſe the Inſtruments do never agree in all things: even as

Hath the Voice
is made?

Sighing.

What is
properly
a Voice?

The Differences
of Voices, or
Speeches.

Bells

Bells made of the same matter, the same weight, the same form, and by the same workman, do nevertheless always differ in sound.

Parts of Voice or Speech. The *Parts of the Voice or Speech*, are Vowels and Consonants. We represent the Vowels only by five Letters, because the root of the Tongue is only moved by so many motions. But when a Vowel is further cut and modified, in the fore part of the Tongue, by the Lips and Teeth, it becomes a consonant, which therefore cannot be uttered without a Vowel, because that is its matter, seeing it arises only from a Vowel modified and cut: just as from the confused sound of a Pipe, an Articulate and Harmonious sound is made, when after a certain Method, the sounding Air is again stopped and cut by the Fingers.

Chap. XII. Of the OESOPHAGUS or Gullet.

THE OESOPHAGUS which some term *Gula*, others *Stomachus*, and *Celsius Aurelianus Via Stomachi* and *Ventris* the way of the Stomach and Belly, in English the *Gullet*, is the Pipe or Funnel of the Stomach, as the *Wesand* is the Pipe of the Lungs.

Its Situation. 'Tis so *Scituate*, as that it begins in the Throat, where it is termed *Pharynx*, and from thence goes down right forward, under the *Wesand*, into the Stomach. And when it is come as far as to the fifth Vertebra of the Chest, giving way to the Aorta, which passes through the middle thereof, it bends to the right Hand; afterwards it rises again to the left great Artery, and at the eleventh Vertebra, through the Diaphragma or Midriff it enters the left mouth of the Stomach, accompanied by two Nerves arising from the sixth pair.

Its Vessels. It hath a few *Veins* from the Cava, the Azygos, Intercostal and Jugular Veins.

It hath *Arteries* from the Intercostal Arteries, and the internal Carotides.

And *Nerves* from the sixth pair.

Connexion. Its *Connexion* is, at the beginning with the Jawes and Larynx, by the Coat of the Mouth, which is common to it and the Stomach. To the Vertebrae, the Trachea and neighbouring parts 'tis joyned by Membranes arising out of the Ligaments of the Back.

When the Gullet is diseased, Medicaments are applied to the Back. And because it lies upon the Spina or Back-bone, therefore when it is Diseased, we apply external remedies to the Back-bone.

Its Kernels. A *Glandulous Body* grows to the hinder part of it, which affords moisture, to wet the Cavity thereof, the better to assist the swallowing of things. And sometimes it swells so much, as to hinder the swallowing of all liquid meats and drink.

Substance. Its *Substance* consists of a triple Coat, that it might more easily be stretched long-ways and broad-ways.

The *first* is common with the Stomach. This some will have to arise from the Ligaments of the Vertebrae, others from the Pleura, who are therein both mistaken. For it hath its rise, there where the Membrane of the Stomach arises, viz. from the Peritonæum, for it is one continued Body with the Mem-

brane of the Stomach, it is exceeding thin and in a manner destitute of all Fibres.

The *second* is the first *Proper* one, the external being more fleshy, thicker and softer, then the other; being as it were a Muscle bored through, being commonly reputed to be interwoven with round and transverse Fibres. Also *Hofman* doth thereby prove it to be a Muscle, because it suffers Convulsions and Pal-sies.

The *third* is the second *Proper* one, internal, more Nervous, somewhat subtiler and harder, being commonly said to be interwoven with streight and long Fibres. It is contained with that Membrane, which covers the Palate, Throat and Lips, and therefore when a Man is ready to vomit, his lower Lip trem-bles.

Howbeit, contrary to the vulgar opinion aforesaid, our Eyes can witness, that the inner Coat is furnished with transverse and circular Fibres, the external with straight and longish ones.

The *Muscles* of the Gullet which other *Muscles* have passed over in silence, are *four*.

The *first*, is the same I spoke of before, treating of *Larynge*. It is only one like a Sphincter Muscle compassing the Gullet. And therefore *Riolanus*, *Spigelius*, and *Veslingus* term it *Musculus Oesophagus*, being the Authors of that name.

The *second*, is the *Sphæropharyngæus* by them so called, arising from the internal acute process of the Sphænoïdes, and being obliquely implanted into the sides of the Oesophagus, that it being drawn upwards and widened, it may be the more wide to receive in meat.

The *third* is *Scylopharyngæus*, which arising from the Bodkin-shap'd acute process, is stretched out to the sides of Oesophagus; which both Dilates and Amplifies.

The *fourth*, is *Cephalo-pharyngæus*, commonly said to arise from the Chin, but according to late Authors, from the lowest part of the Heads-top where it is nearest the Neck; and is inserted with a various contexture of Fibres into the beginning of the Oesophagus, where it is larger: and therefore because of its Latitude and Fabrick, it seems to be two.

The *Action* therefore of the Oesophagus is Animal; seeing it is performed by Muscles and not natural, as the vulgar opinion is of all Authors, and swallowing doth doubtless depend upon our free will and liberty.

Now swallowing is performed after this manner: when any thing is to be swallowed, that same first Muscle which *Galen* terms *Sphincter* doth every way contract it self, whereupon its oblique Fibres, which reach from the Oesophagus to the Larynx, are made transverse, which being done, the Larynx is lifted up, and the Gullet is depressed; and the Cavity of the Gullet so depressed, is made more narrow. Hereunto the fourth Muscle is assistant. For as the first being contracted, embraces the meat which by chewing is brought into a round Mass, and so bears it down: so this fourth Muscle also contracting it self, comes out as it were to help, and that the meats received in at the Mouth may not go back, it straitens and repels them on every side, and transmits them into the Gullet, so that by both these Muscles contracted, and the Semicircular joyned therewith a perfect circle as it were and Sphincter is made, viz. by the fourth in the upper part of the Pharynx, and by the first in the lower.

Whether Swallowing be a Natural or Animal Action?

The Use of the Gullet is, that by it as by a Funnel, meat and drink may be passed into the Stomach.

Why sometimes solid meats are more easily swallowed than liquid.

And liquid things are indeed more easily swallowed then solid; contrarywise in some sick persons solid meats are more readily swallowed then liquid, because the faculty is more provoked by a stronger object, being otherwise lulled a sleep as it were; especially in the Palsie.

Chap. XIII. Of the Neck.

The Neck.

AN Appendix or Appurtenance to the middle Belly. is the NECK, as a medium between the Head and the Chest.

Why call'd Collum.

'Tis termed Collum a Colendo, because it is wont to be adorned: or a Colle from an Hillock, for it arises out of the Body, as an Hill out of the rest of the Earth.

Its Magnitude.

'Tis oblong for the modulation of the Voice; and therefore Animals which utter no true Voice, as Fishes and Frogs,

have no Necks: and those which make the greatest Voice, have the longest Necks, as Cranes and Geese, &c. By the use of Venerary the thickness of the Neck is altered, because heat distends the Aspera Arteria, the Carotides, and the Jugular Veins. Whence it was an ordinary Practice among the Romans to measure the Brides Neck the day after the Wedding, by which they knew whether she were a Virgin or Corrupted, as we learn out of Catullus and Mercurialis.

The hinder part of the Neck is properly termed Cervix. Now the parts of the Neck are either external, as the Skin, Muscles, &c. or internal, as the Vessels which run through the Trachea and Oesophagus: of the latter I have spoken, of the rest I shall speak in their proper places.

The Use of the Neck is, 1. For the Oesophagus, Wind, and Lungs. Hence Creatures that have no Lungs, as Fishes, have no Necks. 2. To be instead of an Hand to some Creatures, to take their meat with, according to Galen. 3. That it may afford Nerves to the fore-parts, the Shoulder, Cubit, Hand, Midriff; for those creatures only have these parts who have Necks.

Its Parts.

Its Use.

THE



THE THIRD BOOK OF THE Uppermost Cavity, viz. THE HEAD.

*Why the Head
is placed so
high.*

THe third or *upper Venter* or Cavity is the *Head*, the chief mansion-house of the sensitive Soul which is placed in the top of the Body, for the Eyes sake,

which are there placed as in a Watch-tower; and requisite it was that the Brain should be near the Eyes, because they have soft Nerves, which cannot be carried far.

Its Figure.

The Head is round like a Globe, but a little flattened withal, and longish.

Greatness.

'Tis greater in Man than other Creatures, because of the Largeness of his Brain.

Substance.

And for more safeguard, the Head is altogether bony.

Division.

The Head is divided into the *Hairy* part, and *that which is without Hair*.

The former is termed *Calva*, the latter *Facies*.

Calva.

The external parts of the *Calva* are these following.

Sinciput, which is the forepart reaching from the Forehead to the coronal Suture.

Occiput, which is the hinder part, reaching from the Lambda-fashion'd Suture, to the first Vertebra of the Neck.

Vertex, which is the part situate between the two former, bunching our.

Tempora, the Temples, which are the Side-parts, between the Eyes and the Ears.

Now the parts which constitute the *Calva*, are some of them external and cloathing, others internal and contained. The former are either common, as the Scarfskin, the Hairy-skin, the Fat, the fleshy Membrane: or proper as the Pericardium, Periostium, the Muscles, the Bones, the Meninges. The contained are the Brain, the Petty-brain, and the Marrow, which is partly in the Skull, partly in the Back-bone.

The Face.

The smooth part of the Head, called the Face besides the parts containing, hath parts proper to it self, viz. the upper part which is called the *Forehead*, and the lower in which

are the Organs of the Senses; as the *Eyes*, *Nostrils*, *Ears*, and *Mouth*, wherein the *Tongue* and other parts are concealed.

Chap. I. Of the Hairs.

IN the Head there is the greatest plenty of Hair, therefore the Nature of the Hair may conveniently be delivered in this place: though considered as an Excrement, it does not belong to this place.

Hairs are found well-near in all Creatures that engender their young ones within their bodies, as *Aristotle* assures us: instead whereof Fishes have scales, Birds feathers, and some Beasts as the *Hedge-hog*, have long sharp prickles.

Now the Hairs are indeed Bodies, but not parts of the body, unless in a very large signification, as when we say some parts serve only to adorn the body.

The immediate material Cause of which the hairs are made, is certain fuliginous and excrementitious Vapors, thick and earthy, yet somewhat glewish and clammy.

Its therefore false, which some affirm, that the Hairs and Nails are nourished and generated of good and laudable nutriment. For they grow even in persons consumed and pined away, and being cut, they grow again in all ages of a mans life: and the oftner they are cut, the sooner they grow again. Yea in dead men, as on thieves upon the Gibbet, &c. they grow. See *Parents* at the end of his Book, who had an embalmed body in his house twenty four years together, the Hairs and Nails whereof grew again as often as they cut them. They are therefore bred of sooty Streams and Vapors, of the third Concoction, or of the fleshy substance it self, by whatsoever heat resolved into vapors.

The remote Matter, is nothing seminal out of which the hair sprouts as a flower, nor any fat substance enclosing

What creatures have Hair.

Whether Hair & Nails grow of good nutriment.

The remote matter of Hair.

clining to the Nature of the Seed or Flood, but a superfluous moisture; especially that which is contained in the Kernels. And therefore where there are Kernels, in those places there are commonly Hairs, as at the Ears, in the Arm-pits, in the Groins, &c. And if sometimes there are Kernels without Hairs, this want of hair springs from a too great quantity of humors.

For the Matter in which, or the Place where hairs are bred, ought not to be too moist, nor too dry; as we see nothing grow in a wet fuliginous Soyle, nor in ground over dry and parched.

And therefore the Skin, because it is a temperate part, as the place of Generation of hairs; but if it be too moist, or too dry, as in some persons it is, the hair does not shoot forth: and therefore crusted Animals, as Crabs, Lobsters, Oy-
Why crusted Animals have no hairs. fsters, &c. have no hairs.

The Skin therefore on which hairs must be bred, ought to be moderately dry, least the hair should fall from its root; but it must not be immoderately, but lax and rare, least otherwise the hair should not make its way through. And therefore hairs may grow all over the skin, because it is every where porous, and every Pore hath the root of an hair fastned therein, excepting the palmes of the hands and the soles of the feet, which parts because of their continual motion and wearing, have no hairs, and because they were to be of an exquisite sense. And for this cause there grows no hair upon a Scar, because it hath no Pores.

Hairs also do sometimes grow on the inner Membranes of the Body, in the Heart as was said before, in the Womb, in the Urinary passages, Witness *Hypocrates, Galen, Schenkius*. Hair was found in the stomach by *Lieer*, and lately in *Norway* hairs were voided by vomit from the Stomach, whether bred there, or taken in. At the Danish *Hellefont* red hairs were lately taken out of the muscular flesh of an Ox leg.

The Efficient Cause of hair, is not the Soul, nor any vegetative hair-making faculty, but moderate heat, drying up those fuliginous vapors, and thrusting them forth into the pores of the Skin.

These three things already explained, are the chief Requisites for the Generation of Hair, viz. The Matter, the Place convenient, and Heat.

From whence by the Rule of Contraries, the Cause of Baldness may be gathered, viz.

I. When Matter is wanting.

2. When the Skin is Originally too dry, and afterwards grows drier, and is not moistened by any neighbouring part. Now the fore-part of the Head is here to be understood, which is commonly the only bald place; for no man, according to *Aristotle*, becomes bald on the hinder-part of his Head. For either Fat or other moisture in the hinder-part and the Temples keep them from baldness; fat in the fore-part, the Skin becomes dry and hard like a shell, and therefore is bald.

3. By reason of too much or too little heat. For weak heat does not sufficiently dry the matter, as in cold and moist persons, and such as are in years. And therefore the humor growing over hot by carnal Copulation, is the cause of baldness, and for this cause Boys and Eunuchs do not become bald.

4. Also four Husbandmen near *Bruxells* became bald by poyson, as *Franciscus de Paz* the King of *Spain*s Physician observed, and wrote thereof to *Nicholas Fon-*

tanus; And *Hamelmannus* in his Annals tells of an Horse of the Count of *Oldenburg*, which by poyson was made bald hither, because this poyson had some specifical contrariety to the Hairs, or because the Spirits being extinguished, and the vigor of the Body quelled, the roots of the hairs could not be retained in the Skin. Such a poyson is the fat of a certain Whale in the Island of *Feroe*, newly taken out, by which Copper-vessels are also broken.

The Hairs are commonly divided into such as are bred in the womb, and such as grow afterwards.

Those bred in the Womb are threefold, those of the Head, of the Eye-lids, and the Eye-brows. *Hairs bred in the womb.*

The Hairs which grow afterwards, are such as spring up when a man comes to a just age; that is, in a boy when he begins to breed Sperm, and in a Maid when her Courses break forth, for then the Skin grows open.

Also these are threefold: for 1. Hairs breed on the Share, seldom in the Womb and the Heart. 2. In the Arm-pits, also in the Nostrils and Ears. 3. On the Chins of men, but not of women; for in women their Courses spend the matter of hair which should make a beard, and therefore sometimes, when their Courses are past, women have hairs growing on their Chins. It was a rare case for a young woman of thirty years of age, one of the Arch-duches of *Austria*'s Women, to have ever since she was a Girl, before her courses brake forth, a long beard with mustachios like a man. And I saw such a like Girl not long since in the Low-countries, who was also hairy all her Body over. Lately *Helena Marfwin* in *Fionia*, had a Girl with a long beard of a reddish yellow colour.

The End or Use of Hairs,

Use of Hair.

I. Is to cover the Parts.

II. To adorn them. And this is chiefly seen in the Hairs of the Head and Face. For

1. The Hairs of the Head do shield the Brain from external injuries of cold and heat, &c. So in *Ethiopia* by a peculiar thrumming of their hairs, they are defended from the heat. And as a man hath the greatest Brain of all Creatures, so hath he thereon most plenty of hairs.

2. They moderately heat, as otherwise in the Head there is no Fat to keep it warm: but rather a bony substance, and that far distant from the Heart. Now the hairs according to the advice of the Physician, are to be let grow, or to be cut off in this or that person, but they must not be shaven off, because thereby Defluxions are caused. So also the beard does cherish and moderately warm the Chin. In persons that are recovering out of sickness, the hair must not be cut off, for fear of a relapse, touching which Question see *Siramus*.

3. They adorn: for bald persons and thin-hair'd are deformed. So the Beard also adorns a man, and makes him venerable, especially if the hairs be spread all about. But in women there was no need of so venerable an appearance.

III. To purge the Humors and Spirits, and the whole Body of superfluous sooty steams. And therefore frequent cutting the hair, quickens the sight, and *Celsus* in a long Defluxion of Rheum, bids us cut the hair to the skin. *C. Aurelianus* says that in the Phrenzie, when the hair is cut off, the parts transpire, being freed from a great burthen. Hence a reason may be drawn, why *Helmontastus* an Asses milk, could tell
whether

whether she had been curried and combed that morning or not.

IV. To afford signs whereby to know the Temperament, Manners and hidden Diseases of every person.

Their Form. The Form of Hairs is not the Soul, as many would have it, because in persons that consume, and such as are dead, the hairs grow; and those who conceive with *Plenius*, that there is a Soul in persons dead twenty four years, I leave the Readers to make an estimate of their Wisdom. Nor do they retain a vegetative life in dead persons, for so the whole man should not die, nor is there any thing in a dead Carcase, that should rather preserve this life, then the sensitive or rational, nor to say that these ignoble Parts by the long-lasting of their lives, should excel all other parts. Plants indeed spring living from the lifeless Earth, but out of a living Seed, which I deny to be in the Hairs, and therefore they stick not in the Body like Plants, nor are bred there-out. Nor must we say with *Plotinus*, that certain reliques of life remain after death, as warmed rooms remain hot, when the fire is out; for such Reliques of life could not remain so many years. The form therefore of the hairs may be described by their accidents, which are these following.

Magnitude. 1. *Magnitude*: Now the Head-hairs are longest, because the Brain is greater then the rest of the Kernels: also they are thickest, because the Skin of the Head is most thick, howbeit it is lax and open, and contains sufficient moisture.

According therefore as the Skin is thick or thin, rare or compact, and the humor plentiful or scanty, and the heat weak or strong, the hairs become thick or thin, hard or soft, plentiful or scanty, &c. He had store of hair on his Head, who could suffer himself to be shot in the head with a bullet, and had no hurt, whom *Bu-bequius* saw in his Voyage to *Constantinople*. Yet they grow not infinitely, because the Exhalations are not so plentiful, nor does the expulsive Faculty work infinitely.

Figure. 2. *Their Figure*: The hairs are straight and flat, in such as abound with moisture, but curled in such as are dry. Therefore curled hair is harder then that which lies flat. Hence all Black-mores are curle-pated, because of their dry Temperament. But the Scythians and Thracians have long flat hair, because they are moist, according to *Aristotle*. Again the hairs are straight because of the straightness of the passages through which they break forth; and crisp because of the crookedness of the said passages. The augmenting Glass informs us that the hairs are quadrangular; though others will have them to be round because of the roundness of the Pores.

Also they are porous or hollow within, as the Disease *Plica* in *Poland* does shew, and the hairs of an Elk. Again because they may be split, they have Pores, according to *Aristotle's* maxime.

The cause of the colour of the hair. III. *Their Colour*: which in Brutes follows the colour of the Skin; and in men is exceeding variable, according to the Country, ambient Air predominant Humor, Age, &c.

For those that dwell in hot and dry Countries, have their hair not only dry, crisp and brittle, but also black, as the Egyptians, Arabians, Indians; also the Spaniards, Italians, and part of the French have their hair for the most part black. They who dwell in cold and moist Countries, have their hairs not only soft and straight, but for the most part yellow or white, as the

Inhabitants of *Denmark*, *England*, *Norway*, *Swedland*, *Scythia*, &c.

Again the predominant Humor makes the Colour of the hairs: as in flegmatick persons, the hairs are for the most part white, and so of the rest.

Also the Variety of Heat makes variety of Colours: for immoderate heat makes black hairs: for a vaporous Excrement is raised by the heat, and is changed into an exact sooty stream. But temperate heat makes the hairs yellow; more temperate makes them red; a weak heat makes them white. But both these causes of Colours do easily concur in the hair, as when flegm abounds, weakness of heat is joyned therewith, and when Blood abounds, heat is moderate, &c.

Also a change in the Colour is made in respect of Age, as also of other accidents. For grown persons have their hair not only thicker, harder, stronger and more plentiful, but at length also grey and whiteish.

But no Hairs on the Body of Man are Naturally green, or blew, though there are both green and leek-colour'd Choler in Mans Body; the cause whereof is not the thickness of the hair, incapable of light, as *Cardan* imagined, because the hair is capable of being yellow, its thickness nothing hindring; but, as *Scaliger* rightly philosophizes, seeing every colour is not agreeable to every Plant, no more is it to the hairs. Yet I have seen green hair'd men at *Hafnia*, and those as work Metals have their hair commonly green. *Marcellus Donatus* relates of *Antonius Maria Catabenus*, grey hair'd through Age, how that much Choler mixt with blood abounding in his Body, not only his Skin became of a Verdigreese or yellow-green colour, but his grey hairs were also died of the same hue.

The Ancients conceived that grey hairs did proceed from driness, as the Leaves of Trees when they are dried, look white.

But *Aristotle* confutes them. For those who go with their heads covered, do sooner grow grey, and yet are not so dried, as those that expose their heads bare to the air. Again some are grey as soon as they are born or quickly after, which cannot proceed from Dryness.

Now they grow soonest grey that go alwaies with their Heads covered, because the heat cannot be fanned, but is overwhelmed and strangled, which being extinguished, an external heat is introduced; so that putrefaction is the cause of grey hairs, which sprung from scarcity of innate heat, which cannot so digest the humors as in youth. And the outmost and smallest end of the hair is whitest, where there is least heat.

Now why a white Humor should arise from putrefaction, the Cause is, according to *Aristotle*, because a great part is turned into Air, which being well mixed with an earthy and watry Substance makes whiteness. Hence also it is apparent, why men are soonest grey about their Temples, because there great and fleshy Muscles are placed under the Skin, which through moisture do easily putrifie. Add hereunto, that the Bones of the Temples are very thin, and therefore extraneous heat can easily pass through them.

The cause of grey hairs.

Why they are soonest grey-hair'd that go with their Heads covered?

Why Men are soonest grey about their temples?

Chap. II Of the Membranes without and within the Skull.

THE EXTERNAL MEMBRANES which compass the Skull, are two: The PERICRANIUM and the PERIOSTIUM which compass the Brain; also there are two Meninges or *Matres* so called, viz. DURA MATER and PIA MATER, that is to say a thick Membrane and a thin one, which perform the same Office in their Cavity, which the Pleura performs in the middle Cavity and the Peritonæum in the lowest.

The Pericranium.

The PERICRANIUM is a Membrane thin and soft, compassing the Skull, and springing from the *dura Mater* coming out at the Sutures of the Skull.

That it springs from the *dura Mater*, the extraordinary Consent between the Brain with its Meninges and the Pericranium, does sufficiently prove, which cannot be by any other way more conveniently made forth. Moreover, this production of the Pericranium from the *dura Mater*, is manifestly visible in Infants, in whom the Moles of their Heads are not yet sufficiently closed. Those Fibres wherewith *Horslius*, *Spigelius*, and *Laurentbergius* do conceive that the Pericranium is only fastned to the *dura Mater*, do not go unto the Throat: for the Bones being by little and little hardened and compressed, that same Continuity of the Pericranium and *dura Mater*, was broken off with Age, from whence arose that appearance of Fibres which hath deceived some.

Periostrum.

The PERIOSTIUM is a most thin and nervous Membrane, and therefore exceeding sensible, by help whereof, all the bones saving the teeth being compassed therewith, become sensible.

I distinguish these two Membranes with *Vesalius* and *Baehnius* against *Fallopium*, *Laurentius* and others, who confound them, seeing they may be accurately separated by a skilful Anatomist.

Now the various Muscles about the Head shall be explained in their proper place.

Crassa Meninx.

The CRASSA MENINX or harder Membrane called also DURA MATER, because of its thickness and hardness, and because many conceive all the Membranes of the Body do arise out of this and the *tenuis Membrana* or *pia Mater*, does cover the Skull all over on the inside, and all its Cavities and hollownes; and sticks strongly to its Basis, so that some have thought it took its Original from thence.

Now it compasses the Brain also loosely, on the upper side, and covers the inside of the Skull. (For whereas *Hildanus* and *Varolius* have observed that it is straitly fastned to the Skull, that was besides the ordinary Course of Nature) that there may be some distance between, as there is between the Heart and the Heart-bag, both in living and dead bodies, though in the latter it is greater, by reason of the defect of Spirits and the falling in of the Brain, which I grant *Olbasius* and *Hofmannus*; and this is so contrived that the swelling Vessels of the Brain, may not be compressed, and that there may be no hindrance of the

The Brain moves.

Motion of the Brain, which is made up of Systole and Diastole, and is continual, as may be seen in Wounds of the Head, new born Children, and most vehement pains of the head, as *Fabricius Hildanus* hath observed:

And I my self have frequently seen this motion in wounded persons. Strange therefore it is that some learned men will needs deny this motion. But it is a very hard task to assign the true Cause of this motion: Some make it to be the Meninges; others the Arteries; others the Substance of the Brain. But it is ill ascribed to the Meninges: for a great portion of the brain being taken away, and the Meninges themselves, the brain was observed to move in a living Sheep, by the renowned *Riolanus*. They judg better, who ascribe the same to the Arteries, for the motions of the Brain and Arteries do happen both at one and the same time, as may easily be observed in Fractures of the Skull, and in the Heads of Infants. Yea and *Waleus* observes that in those who being wounded in the Head to the Brain, have extream anguish, only certain conspicuous Arteries do move, and not the Substance of the Brain; and when the parties wounded gather strength, the motion of their Brain evidently returns. Also *Cuiter* hath observed in living Lambs, Kids and Dogs, that the brain it self hath no motion but only the Arteries. To him *Olbasius* gives consent, because the motion is most observable about the Cavities of the *dura mater*, where are most Arteries. And therefore I conceive we must not have recourse to the Substance of the brain: which is also soft and flaggie, and sufficiently indispensed for motion. But the chiefest motion is observed at the full of the Moon, by reason of the working of the humors at that season. But that also springs from the Arteries, which are more distended with blood: for the motion of the Heart becomes quicker or slower, according to the various Influence of the Stars. That the motion of the brain should answer the motion of the Lungs, I have no sufficient sign to prove.

Now it is fastned to the *pia mater* and the brain, by Vessels; to the Skull by thin membranous fibres springing out of it self, passing out through the sutures, and constituting the Pericranium.

This Meninx or Coat is double, as the rest of the Membranes are. The external part respecting the Cranium, is hard, rough, and of a small sense, because of the hardness of the Skull which it was to touch.

The inner part is smooth, slippery, brightly shining and white, being more drenched with a waterish moisture.

It is fourfold where it distinguishes the Brain from the petty-brain, in which place Dogs have a bone underpropping their brain, that it may not bear hard upon the Cerebellum, Branilet, or petty-brain.

But on the Crown of the Head it is doubled, where it divides the brain into the right and left part: and because the Reduplication is in the hinder-part broad, and grows afterwards narrow by degrees, yet not to a point, so as to represent a Reapers Sickle, therefore they term this Body *Falx* the Sickle. See Tab. II.

And while it is thus multiplied, it constitutes.

Cavities hollownes, being receptacles of abounding blood and Spirits, and they are four in number; which *Galen* sometimes calls the *Ventricles* of *dura Mater*; and others call them *Sanguis ductus*, Cisterns of Blood. *The upper Cavities.*

The first two begin at the Basis of the Hind-part of the Head, by the sides of the Lambda-shap'd Suture, where the Veins and Arteries disburthen themselves. The Veins truly, of the jugular branch are manifestly inserted, and receive blood out of the Cavities; but the Arteries, whether mediately by certain branches of the Cavities,

The FIGURES Explained.

This TABLE Represents the Coverings of the Brain both proper and common, in the same order in which they are represented in Anatomical Dissections.

- FIG. I. Shews the external Parts.
- AAA. The Skin and the Scarf-skin with the Roots of the Hairs.
- B. The true Skin separated from the Scarf-skin, C.
- DDD. The Membrana Carnosa furnished with little Veins.
- EE. The Muscle of the Fore-head out of its own proper place, receiving the Nerves which come out of the hole, O.
- FF. Fat spread over the Skull.
- G. The Pericranium lying upon the Periostium in its natural Situation.
- I. The same separated from the Periostium and turned inside out.
- K. The Periostium spread out upon the Skull.
- L. The same plucked off from the Skull.
- MM. The Skull naked.
- N. The Coronal suture.
- PP. The Sagittal suture.
- QQ. The temporal Muscle as yet covered with the Pericranium.

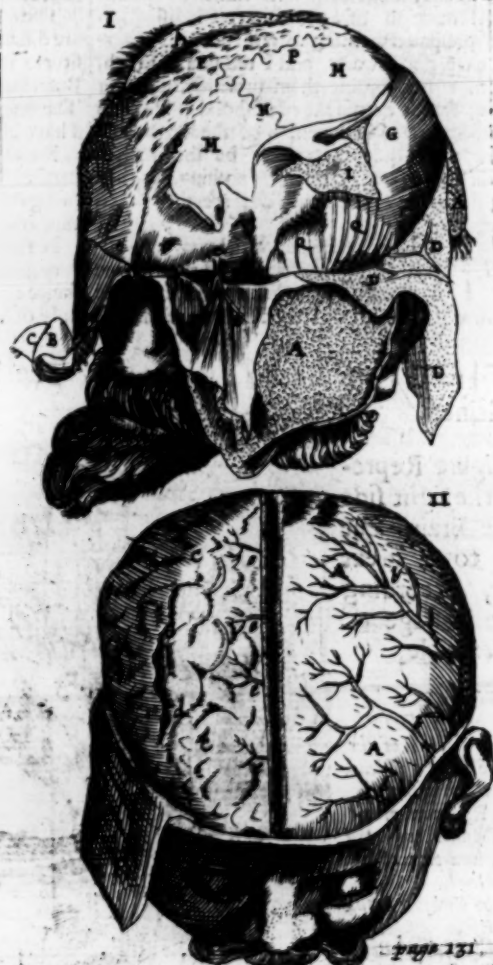


FIG. II. The Skull being taken away this Figure discovers the Coats of the Brain.

- AA. The dura Mater covering the left side of the Brain.
- bbb. Veins and Arteries sprinkled up and down the same.
- CCC. The Brain covered only with the pia Mater.
- dd. The turnings and windings of the Brain.
- ee. Vessels sprinkled up and down the pia Mater.
- F. The dura Mater drawn downwards.
- G. The upper Cavity engraven in the dura mater.

Cavities, as *Walæus* suspects, or knit immediately to the Cavities themselves, do disburthen themselves, into the Cavities. And these two being afterwards united, do make up.

The third. The third which is longest of all: For it goes all along the Head to the tops of the Nostrils. *Galen* sometimes calls it a Vein, because it contains store of Blood. And when these Cavities are opened, an immeasurable quantity of Blood comes out by the Nose, which is supplied from the Arteries.

The fourth Cavity, not reaching to the Skull as the former, is short, and goes inwardly between the Brain and the Brainlet, unto the *Glandula pinealis*.

It arises, where the three former meet together, and this beginning some from *Herophilus* call *Torcular* the Wine-press; and *Nymmannus* conceives that this part is chiefly obstructed in the Apoplexy. But I. We

do sometimes allow thereof, as a remote Cause. for all that accident is to be referred to the noble Ventricle. 2. Vital blood may be brought to the Brain by the *rete Mirabile*, whence Vessels go for Nutriments take, to the substance of the Brain.

The third, or the uppermost of the sickle; and the fourth Cavities, do seem to me to end into the two former, or greater lateral ones; in which I follow *Fr. Sylvius* exceedingly vetted in the Anatomy of the Brain: and that not by a freight passage, but inclining to the sides; so that there is no common course of these four Ventricles; though these greater lateral ones are joyned by an intermediate passage or Channel. Yet here also I have found some diversity according to the variety of subjects, so that they have sometimes met, and sometimes been separated. *Riolanus* makes the *Torcular* with *Galen* to be in the third longitudinal Cavity, because it distributes blood into all parts of the

the Brain and Brainlet or Cerebellum, which Reason holds truer in reference to the Arteries.

The lower Cavities. Besides those four Cavities or Ventricles already described, three others, by the Information of Sylvius have in dissection presented themselves to me; which nevertheless, I have not always, and I tell you so much, least any man not finding them presently in one or two Bodies, should accuse me of falshood. Riolanus accounts them to be Coherences of the Duplicated Brain, spread under the greater once, by the interdependency of the *pia Mater*. Which is nothing, for they have Cavities as the others have, nor are they naked Coherences.

The one of these, which was also observed by Vesalius, is carried through the lowest part of the Sickle, and therefore I have termed it, the lower Ventricle of the Sickle;

and for distinctions sake, I have termed that which is commonly call'd the third, the upper Ventricle of the Sickle. This lower Ventricle of the Sickle, ends into the fourth Ventricle.

The other two smaller lateral ones, on each side one, are distant about a thumbs breadth from the greater, situate in the *dura Mater* which distinguisheth the Brain from the Brainlet, not being so long as they. The one of them goes into the great lateral Cavity; I have also seen them ending into the fourth.

From the Cavities arise the branches or creeping jugular Veins, and into them the *Arteriae Carotides*, being distributed upwards and round about, and opening into them by mutual Anastomoses.

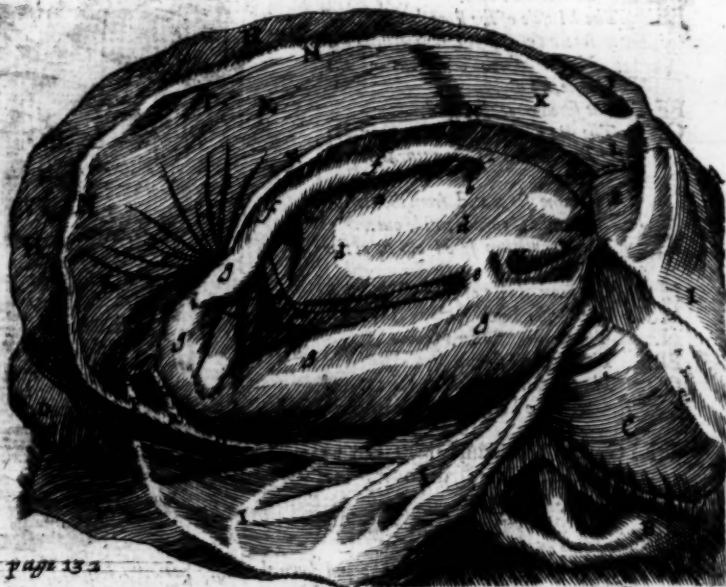
Now the blood is contained in these Cavities in very great plenty, because the bulk of the Brains substance is very great, and they perform the office not only of Veins but of Arteries also, seeing they Pulse as

The FIGURE Explained.

This Figure Represents the right side of the Brain, cut away to a great depth, according to the passage of the Ventricle.

- A. The Nose.
- B. The right Ear.
- CCCC. A portion of the Skin of the Head hanging down.
- D. A Rudiment of the Muscle of the Hind-part of the Head.
- E. The Socket of the Eye.
- F. The Forehead Bone.
- G. The Bone of the Hinder-Head or Occiput.
- HH. The left side of the Brain, covered as yet with its *dura Mater*.
- III. The *dura Mater* of the right side hanging down.
- KKK. The Falx or Sickle.
- L. The End of the Sickle at the *Galli Crista* or Cock-Comb.
- MMM. The upper Cavity of the Sickle.
- NN. The lower Cavity of the Sickle.
- O. The greater Right-hand lateral Cavity.
- P. The ingress of the upper Cavity of the Sickle into the greater lateral Cavity.
- Q. The fourth Ventricle between the Brain and the Brainlet.
- R. The ingress of the fourth Ventricle into the greater Lateral one.
- S. The common passage of the greater lateral cavities.
- TT. A portion of those great Vessels which pass into the upper cavity of the Sickle.
- VV. Part of the great cleft in the Brain.
- ∞. The lower and outer part of the right Ventricle, where a little twig of the *corotick Artery*, pierces as far as the *Plexus Choroides*.

The II. TABLE.



- y. The hinder and larger part of the right Ventricle.
- z. A roundish cavity of the right Ventricle resembling the finger of a Glove.
- a. The upper and inner part of the right Ventricle, under the *Corpus callosum*.
- b. The descent and orifice of the right Ventricle going into the third or middle-most.
- ccc. The Glandulous intertexture called *Choroides*.
- dd. The Root of the spinal Marrow.
- e. The Brain continued to the root of the spinal Marrow.
- ff. The *Corpus callosum* so called.
- ggg. The hinder and lower part of the Brain, continued to the *Corpus callosum*, and forming the cavity of the right Ventricle.
- hh. A portion of the left side of the Brain appearing under the Falx or Sickle.
- ii. Little Arteries creeping along the Surface of the right Ventricle.

the Arteries do. Which *Waleus* could never perceive in the dissected brains of live Creatures, nor in fractures of the Skull. Though it be evident even to those that open the Skull with a Trepan, as *Riolanus* confesses.

The Use therefore of the Ventricles, is not so much to contain the two sorts of Blood, received from the Veins and Arteries; as only to receive the Arterial blood, by means whereof they Pulse. For the Arterial blood communicated to the Brain by the *Arteria Cervicalis*, which remains over and above after the Nutrient of the Brain and Brainlet, and the Generation of Animal spirits, is voided into these Cavities, either immediately or mediately, by the little twigs of the Cavities, as *Waleus* suspects; and from thence through the jugular Veins which are joyned to the Ventricles, together with a thin Skin cleaving to their Walls, it runs back downwards to the Heart, that it may be wrought over again. For that the blood is circularly moved in the Brain also, appears likewise by the Ligatures of live Creatures; seeing the jugular being bound, swells towards the Head, but is empty and lank towards the Cava and Heart.

P. Laurentberg conceives the Animal Spirits are generated in the Cavities, without any firm judgment or probable Reason.

A. Kyperus a most learned Man, conceives that a special use of these Cavities is, to ventilate and cool the blood, for the better service of the Brain and the Generation of Animal Spirits; seeing the extremities of the Arteries do end in them, and the Ventricles themselves are clofed in by a single, cold Membrane. But in my Judgment the Arterial blood does not come into the Cavities, before it be cooled, when it returns from the Generation of Spirits. And then it needs no cooling, being to return immediately through the Veins into the Heart.

The Use of the *dura Mater* is, I. To cover the brain with the Marrow and Nerves thence arising.

II. To distinguish the Brain from the Brainlet, and the Brain it self into two parts.

III. To constitute the *Pericranium*, while it sends Ligaments therefore, through the Sutures.

The *pia Mater* call'd so because of its thinness, doth immediately enclose the Brain, and its Parts and Ventricles, least they should run about; therefore it was to be thin and soft; and it is of most exquisite sence. It is thicker in the third Ventricle, then the rest, if we will believe *Olshofius*. The sence of this Membrane was more dul in him that had three bones growing thereto without hurt, which were seen at *Paru* by my Cofin-German *Henricus Fuiren*: & in that Venetian, who had a pretty large toothed Bone, growing in *Falce* or the Duplication of the *Meninx*, which *Folius* did shew me.

Its Use is; To cloath the Brain, the Brainlet, the Marrow and the Nerves.

Chap. III. Of the Brain and its Marrow in General.

Within the Skull a threefold soft and white substance is to be considered: the BRAIN or foremore Part, the BRAINLET or *Cerebellum* the hindmost part, and the inmost part which lies deep under the

Brain being a white MARROW: which because others do ignorantly confound with the Brain it self; I do thus truly set down the truth of the matter.

The Brain commonly so called hath two parts, the one Internal the other External.

The External part is properly and strictly called the BRAIN and is all that which appears outwardly soft, of an Ash color or yellowish white; which color some conceive to arise from an innumerable company of Veins there disseminated; and this External substance is as it were the bark.

The Internal is the remaining substance which lies hidden beneath the former, being more hard compact and white, which we may call the MARROW, in which are seated the Ventricles commonly so called, but not in the Brain it self; so that

The Brain and Marrow it self Differ, How they differ? 1. In Situation. 2. In Color. 3. In Consistency. 4. By the going between of Lines. 5. In Magnitude. 6. In Figure. 7. In Cavities, which are in the Marrow, not in the Brain. 8. In Nobility.

The white part therefore of the Brain, seems to be buried in the Ash-color'd part, as the Chrystalline Humor is in the Glasse. And though these two substances, the White and the Ash-color'd, do in dead Carcasses putrified seem very closely united, and continued one to another; yet in the fresh bodies of healthy persons suddenly killed, they are separated with sundry lines, so that they may be very well actually severed, if great Dexterity be used, and Dissection be begun presently after the parties death, otherwise they are overflowed with much moisture and fall in.

This middlemost white substance or Marrow, I divide into the round and long Parts.

The Globous or round part, which I shall call the Head of the Marrow, resembles the Figure of the Skull, and is of great bulk, having in it three Cavities or Ventricles commonly so called.

The long part, which I will call the Tail of the Marrow, arises immediately out of the former like a certain Tail, wherein is engraven the *Calamus Scriptorius* or fourth Ventricle so called by some; wherein I hold the true Generation of Animal Spirits to be affected.

And this long Portion of the Marrow, is the beginning and original of all Nerves whatsoever that are in that place; contrary to what is commonly thought.

Also this lengthened Marrow may be considered in a twofold manner: either as it remains still within the Skull, and then the Nerves arise therefrom, which are vulgarly attributed to the Brain: or as it is without the Skull, and slides into the Back-bone, gaining the title of the Spinal Marrow.

But that young Learners may not be confounded, I shall now propound the structure of the whole Brain commonly so called.

The greatness of a Mans Brain is remarkable in proportion to the rest of his body, as *Aristotle* observes.

And for the most part a man hath twice as much Brain

What is properly the Brain.

The Marrow what?

How they differ?

Parts of the Marrow.

The Head of the Marrow, what?

A new opinion concerning the place where the Animal spirits are made.

The Magnitude of the Brain.

Brain as an Ox, viz. the quantity of four or five pound weight, because he is a more noble Creature, and peraps because he goes bolt upright: for when we would have any thing that is moveable to stand upright we put a great weight on the top, to prevent its falling. Yet the skull of a monstrous beast lately found in *Scania*, might preternaturally contain twice that quantity of Brain. The Skull it

Who have most
Brains.

self is kept in the study of *Wormius*. And among Man-kind, Men have more Brains then women. For to them the greatest brain is given, that have most need of brains, and greatest use of them,

for the exercise of sundry excellent Animal faculties. Yet *Spigelius* or *Bucetius* will not allow of this difference of the brains of the two Sexes, moved doubtless by Ocular Inspection, and the great Minds and Endowments of some Women, which the foregoing Age and this of ours have brought forth. But Women are therefore said to have less brains then men, because for the most part they have less bodies.

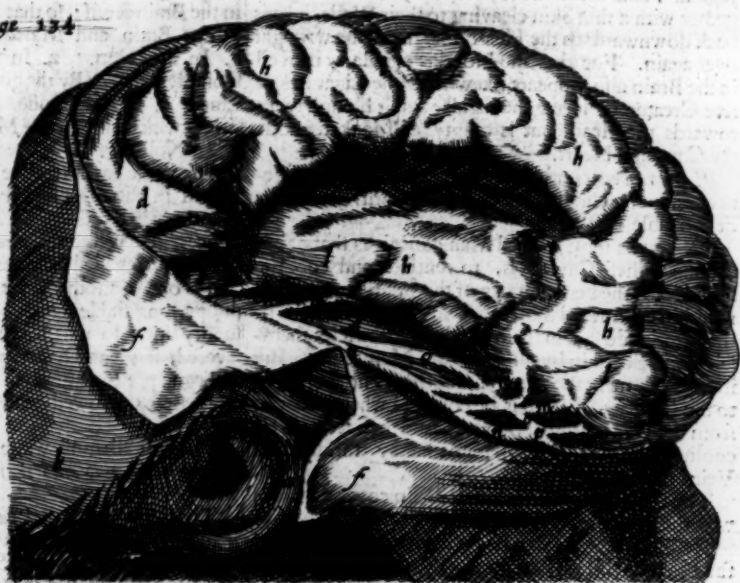
It is of a roundish shape answerable to the Skull; yet inwardly the brain hath certain knobs, which by some are called *Processus mammillares*

Knobs of the
Brain.

The Explication of the FIGURE

This FIGURE *Page 134*

presents the left side of the Brain bowed back into the place of the right, which according to the foregoing Figure is taken away, as also the great Clift of the said Side.



- aa. The left Ear.
- bb. The Skin of the Head hanging down.
- cc. Part of the Fore-head-Bone.
- d. The Socket of the Eye.
- eee. The Hollowness of the Skull, wherein the lower part of the Brain was contained.
- ff. The dura Mater hanging down.
- hhhh. The left side of the Brain invested with the pia mater
- iii. The great Clift of the left side of the Brain, seated over the Root of the Spinal Marrow.
- kk. The left Root of the Spinal Marrow, appearing in the Bottom of the great Clift, with new Rudiments

- of the winding, and Vessels there distributed.
- lll. The windings of the Brain, according to which the Branches of the Carotick Artery are distributed.
- mmmm. The Branches of the Carotick Artery, ending into the larger left-side Ventricle.
- nn. The greater left-side lateral Cavity or Ventricle.
- oo. The smaller left-hand lateral Ventricle.
- p. The Entrance of the smaller lateral Ventricle into the greater

Why the Brain
hath windings.

The outward surface of the brain is full of turnings and windings like those of the Guts: which we must not say were made for understanding with *Erasistratus*, seeing Asses also have them; nor for lightness sake as *Aristotle* would have it; nor that they are without End or Use, as others conceit; but that the Vessels of the brain might be more safely conveyed through those turnings and windings, lest they might by continual motion be in danger of breaking, especially at the full of the Moon, when the brain doth most of all swell within the Skull.

The winding
Clift of the
Brain

The windings of the brain (which I first learnt of *Fr. Sylvius* a great Anatomist) if you diligently examin the matter, you shall find to descend a good

depth, & that the brain doth gape on each side, over & above that same middle division made by the Sickle, with a winding clift, which begins in the forepart, about the roots of the Eyes, whence according to the bones of the Temples, it goes back above the Root of the spinal Marrow, and divides the upper part of the brain from the lower part. Yet now and then, that same great Chink cannot be found or very hardly. Instead thereof I have found a certain small lateral clift on each side easily separable, even in the common section, near the Ventricles, full of the Carotick Arteries.

The inner Surface hath sundry Extuberances and Cavities, as shall be said in the following discourse

The

The Colour. The Colour is white, because the brain, as all other parts hath its original from the Seed, but so, that it hath less of Amplification then of Constitution: and therefore in extreame fastings the brain suffers no diminution.

Its temper-ament. Its Temperament is cold and moist, which appears from its whiteness and moistness. And therefore Hippocrates saies the brain is the seat of cold and clammy humors. For the overgreat heat of the brain is a hinderance both to Reason and Sleep, as appears in Phrenetick persons. Yet is it by reason of the spirits hotter then any Air, as Galen rightly saies; yet is it not so exceeding hot. as the Heart

Why the substance of the brain is moderately soft? Its substance is proper to it self, such as is not in the whole body besides. Hippocrates doth liken it to a Kernel, by reason of the Colour and plenty of moisture. It is soft and moist for the more easie impression of Images and Conceptions, for it is the seat of Imagination: Yet is it not so soft as to run about, but hath a consistent softness, so that what is imprinted therein, may continue for a season: for the brain is also the seat of Memory.

The followers of *Des-cartes* doth weave the brain together of soft and pliable Fiberkies, mutually touching one another, with intermediate spaces of the pores, by which Fiberkies the Images of Objects are imprinted upon the brain. They do indeed excellently explain the reason of Sense, if this *Hypothesis* of theirs were true. But such Fiberkies are not found in the soft substance of the brain, unless we shall mean the beginning of the Spinal Marrow, out of which the little Ropes of Nerves do arise.

It is a rare case for the substance of the brain to be quite wanting, but *Horsius* saw it sometimes much diminished by over great use of carnal Embracements, as his Epistles shew. Howbeit *Schemekius*, *Valleriola*, *Carpus*, &c. saw a Boy without any brain; as also *Nicolas Fontanus* at Amsterdam in the year 1629, who in stead of a brain and spinal marrow, found a very clear water enclosed in a Membrane.

There are Veins in the Brain. Sundry Vessels are Disseminated through the brain. For if you squeeze the substance thereof, many little Driplekies of blood do sweat out: and therefore I conclude with *Galen* that very many capillary Veins and Arteries are there disseminated: which I have also divers times beheld with mine Eyes. Which will then principally happen, as *Fr. Sylvius* observes, when the brain is Flaccid and Friable, because he observed that then it would come off it self from the Vessels, in dissection: and especially if the Vessels by means of Age, or any other waies, are become more solid then ordinary.

Now there are no Nerves Disseminated through the Brain and therefore it is Void of all Sense.

The Veins which are carryed through the substance of the brain are, 1. The five branches of the jugular Veins, some of which go into the Cavity of the dura mater, others are spread up and down through the Coats and substance of the brain. But they, according to the Observation of *Walrus*, are no other then, 2. very small twigs, which on either side go into the substance of the brain, out of the Cavities of dura mater.

There are four Arteries from the Carotides and Cervicales, whereof the former are disseminated into the brain upwards and downwards, the latter into the

Brainlet or Cerebellum. In the Chinks the same Carotick Arteries are carried in very great number, both in the surface and the bottom, which *Fr. Sylvius* conceives to be the cause of that same troublesome pulsing about the Temples in some kinds of Head-ach: though in the judgment of *A. Kyperus* the pulsation of the external Arteries adds somewhat hereunto, as the Cure of the pain doth shew, by opening the said Arteries.

The Use of the Brain according to Aristotle. is to cool the Heart, which *Galen* justly refutes, because the brain is far from the Heart. But there are some Peripateticks who deny that *Aristotle* dissents from the Physitians, while he saith the brain is made to temper the heat of the Heart, and they will have it made to produce Animal spirits: In as much as the Animal spirits cannot be generated, unless the vital Spirits be first cooled But,

The Use thereof is, 1. To be the Mansion of the sensitive Soul, for the performance of Animal Functions. Now the brain is no particular Organ of Sense, as the Eyes, Ears, &c. but an universal one: for judgment is made in the brain of the Objects of all the Senses.

Also it passes judgment touching Animal Motion, whereas it self hath no Animal Motion: But it hath a Natural Motion, communicated from the Arteries, and that a perpetual one of widening and contracting it self, as appears in Wounds of the Head and new-born Children, in the forefront of whose Head, the brain is seen to pant, because their bones are as yet exceeding soft and pliable.

In its Dilatation the brain draws vital Spirit with arterial blood out of the Carotick Arteries, and Air by the Nostrils.

In its contraction it forces the Animal spirits into the Nerves, which like Conduit pipes carry the said Spirit into the whole body, and therewith the faculties of Sense and Motion. And by the same Contraction, the blood is forced out of the Ventricles through the Veins unto the Heart.

The Matter thereof of the Animal Spirits is two fold: viz. Arterial blood full of vital Spirit, and Air. Touching the place of its Generation we shall speak hereafter. For I am not of their opinion who confirme that this Spirit is Generated in the substance of the Brain, or in those Ventricles in the forefront thereof.

2. That the Animal spirit may be contained and kept in the brain as in a Store-house, after it is generated. And the substance, truly, of the Brain is a convenient House and Receptacle for the Animal spirit, seeing it is the same with the internal Marrowy substance of the Nerves, which also contains the said Animal Spirit.

Now I am of Opinion that in the Brain, properly so called, or the Rinde, is contained Animal Spirit for Sense; and that in the whole Marrow Head and Tail, Spirits is kept for Motion, which shall be made manifest in the following Chapter.

The Use of the Brain.

Of the brains Motion.

The Matter of the Animal Spirits.

A new opinion of the Author, touching the use of the Brain and the Marrow.

Chap. IV. Of the Parts of the Brain in Particular, and I. of the leng- thened and Spinal Marrow, and its noble Ventricle.

The right Dis-
section of the Head
must begin at the
lower Part.

See the Figure of
the Section in
the Manual of
Nerves.

SOME with Galen, Vesalius, Fallopius, intending to contemplate what is contained in the Brain, begin their Dissection in the upper part and proceed to the lower, and therefore they do unfitly propound and explain many parts, treading in the steps of Constantinus Varolus, shall take a quite contrary Course, yet such as is true and accurate, beginning at the lower part of the brain and so passing to the uppermost: and I shall afterward propound the order of parts from top to bottom, for their sakes that will needs follow the vulgar and common way of Dissection: where also a third way of Dissection shall be propounded.

The beginning of the Spinal Marrow. Beginning therefore at the lowest part of the Brain, we meet first with the beginning of the leng-

thened Marrow; the progress whereof because it is contained in the Vertebrae of the Spina or Back-bone, therefore it is termed Spinalis and Dorsalis, Modulla, the Spinal or Back-marrow.

And if any one shall think we ought therefore to begin with the brain, because the Spinal Marrow is said to take its beginning therefrom; we answer, that we make the Marrow both as it is within the Skull and in the Back-bone, to be the beginning rather of the brain: and that the brain being divided into two parts, is as it were a certain double process or production of the Marrow it self.

An Objection.

The Answer.

A new Opinion of the Author, that the Marrow is the Original of the brain.

Which is yet more manifest to those that behold the Anatomy of Fishes; for there the Head and Tail of the Marrow, is very great, but the process of the Marrow, or the brain is very little: the Cause whereof is, that Fishes use motion more then sense, intimating that the brain or brain contributes more to sense, and the Marrow it self to Motion. Hence Fish are dull of Sense, but very nimble in motion. And according to this opinion of ours that saying will be verified, than an hard body is fittest for motion, and softer for sense.

A proof hereof.

The FIGURES Explained.

This TABLE presents the fourth Ventricle of the Brain, the Brainlet, and the Corpus Callosum, in several Figures.

FIG. I.

- AA. The Brainlet or Cerebellum and its Globes.
- B. The Worm-like process of the Cerebellum or Brainlet.
- CCCC. The process of the Brainlet, which make the bridge of Varolius.
- D. The beginning of the spinal Marrow.
- EE. Two roots or smaller Processes of the spinal Marrow arising from the Brainlet.
- F. The fourth Ventricle likened to a Pen.
- GG. A portion of the Brain cleaving to the Brainlet.

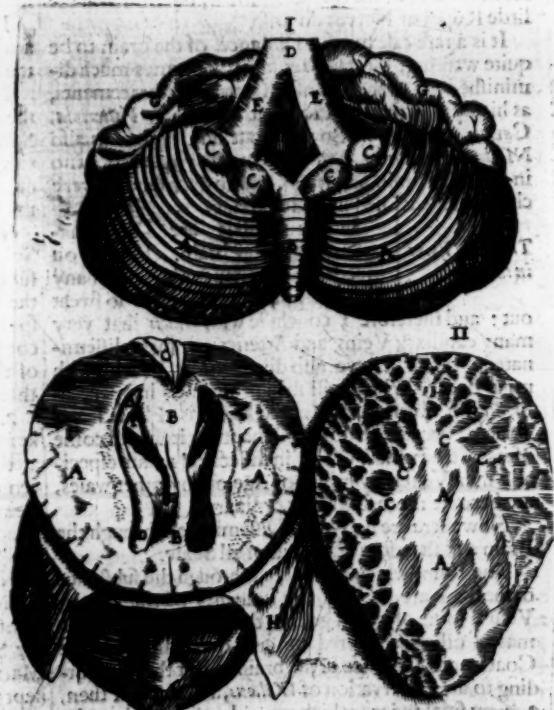
FIG. II.

- AA. The inner whitish substance of the Brainlet.
- BBB. The outer and more dusky substance compassing the white above.
- CCCC. An elegant structure of the Brainlet representing the branchings of Trees.

FIG. III.

- AA. The appearance of the brain cut off in the middle as far as to the Ventricle.
- BB. The corpus callosum drawn a little to the left side.
- C. A portion of the Sickle turned backwards.
- DD. The right fore Ventricle uncovered above.
- EE. The left Ventricle open in like manner.

The IV. TABLE.



- FF. The Plexus choroideus.
- G. A portion of the Speculum or Septum Lucidum.
- HH. The dura Mater drawn away on both sides.
- II. The two Thighs or portions of the Fornix.

The

The *lengthened Marrow* arises as some conceive from the brain alone, according to others from the Brainlet or Cerebellum. But it hath both (to speak now at a vulgar rate) for its beginning.

For it arises from four Roots or Foundations; two of which are greater from the fore-part of the brain commonly so called, two are lesser from the inner part of the Brainlet or petty Brain. From these united, the spinal Marrow seems to be constituted. But it is peradventure a more true opinion to think, that those originals are processes of the Marrow it self, as was said before.

The Substance of the *Medulla oblongata* or lengthened Marrow, is a little harder then that of the brain.

The spinal Marrow divided. One part thereof is within the *Skull*, four Fingers breadths above the great Hole of the Hind-part of the Head. Another and the longest part thereof is *within the Skull* in the *Vertebra's*, from the first of the Neck to the last of *Os sacrum*.

Its Figure is longish and round, The Scripture calls it the Silver Cord. In its beginning it is thicker and larger then elsewhere.

Another division. It is further divided into the *right and left* part, even as the brain is, by the *pia Mater* which immediately invests the same, which may be seen in the Marrow of an Oxe indifferently boyled. Hence there may be a Fallacie of only one side of the body.

Another division. Now it is divided into many little Cords as it were, about the sixth and seventh *Vertebra* of the Chest: and if the spinal Marrow of a body newly dead, be presently plunged in cold water, and a separation of these cords made, you may see the shape of an Horses tail, (especially towards the end) divided into many long Hairs: so that according to *Laurentius*, the Nerves also of the Back and Loyns, do spring from the Marrow of the Neck.

The Coats of the Marrow. It is covered with a tripple Membrane, the first which immediately covers it, is from the *pia Mater*.

The second is from the *dura Mater* and cleaves to the former, Which two, according to the Observation of *Spigelius*, are not separated any distance one from another, as they were within the Skull, but touch one the other.

The third being external springs according to *Galen* from a strong Ligament, which binds together the foreparts of the *Vertebra's*, and in the hinder part ends into a strong Coat, least in bending or extending the Back-bone, the Marrow should be hurt.

A thick and clammy humor is poured round about this Coat, to moisten the same.

Afterwards the Marrow is shut up in the *Vertebrae*, least it should be hurt (as the brain is shut up in the Skull) seeing it is a noble part, and the original of the Nerves. Therefore the Ancients called the Cavity of the *Spina* or Back-bone *Hieran Suriigga*, the holy Pipe.

In the beginning of this Marrow, while it is yet in the Skull, there appears ingraven.

A noble Ventricle in the Marrow. An Hollow Cavity, which *Galen* calls the Ventricle of the Brainlet; others call it the fourth Ventricle of the brain, though it is not in the brain. But I shall term it the noble Ventricle of the Marrow.

This is most solid, most pure, most subtil, but

least of all, for it contains a matter of greater force and faculty then the rest, as *Galen* saies.

And because, after a straight even progress, it is widened on each side, and sharpened afterwards into a point, because of this shape it is called *Calamus Scriptorius*, the Writing Pen or Quill.

Now from the Cerebellum or Brainlet, which is joyned to this Marrow, another and middle half of this Ventricle is constituted, as it were a cover: so that all this Cavity is between the brainlet and *Medulla oblongata*, or production of the Marrow, but the chief Cavity is the lowermost, which is in the Marrow.

The Use of this Ventricle I hold to be this, viz. that it should be the place where Animal spirits are Generated and Elaborated. For this Ventricle is 1. The most pure and subtil. 2. It hath a Cavity sufficient for that purpose. 3. It is seated in such a place, that it can poure forth Animal spirits, into all the Nerves round about it. And therefore *Herophilus* did rightly judg, that this was the most principal Ventricle.

Nor can I devise how it came to pass that certain learned Men could not see these weighty Arguments, who have written without cause, that I assigned the Generation of Animal Spirits to the *Calamus Scriptorius*, without any reasons moving me thereto.

Now must we think with *Spigelius*, that this Ventricle did only result by consequence, out of the round particles of the Brain, touching one another without any design of Nature: for Nature doth nothing to no end, no not when she seems most of all to do so.

Others conceive that the Animal Spirit is bred in the fore Ventricles of the Brain.

But they are full of Excrements, whose receptacles they rather are, as appears by the *Glandula Pituitaria* unto them, and in that they are often found filled with Flegm, and abundance of water.

Others in the *Reti Mirabile*, others in the *Plexus Choroides*.

But in these we hold the Animal Spirit is prepared, but not Generated. For nature is wont to provide interwinings of Vessels for the preparation of any matter: and seeing these Vessels are so smal, how can it be generated in them, especially seeing so many Excrements of the brain flow through the Ventricles.

Others will have them to be wrought in the substance of the brain. Others in the lengthened body of the spinal Marrow. But the Generation of so subtil a Spirit, did require some Cavity, which is also allowed to the Generation of the vital Spirits.

For which cause some have been induced to allot the making of the natural spirit to be in the right Ventricle of the Heart, because there is no Cavity in the Liver.

I am therefore of opinion that the Animal Spirit is prepared in the *Reti Mirabile*, and yet more in the *Plexus Choroides*, and that is generated and wrought up in this Cavity of the *Medulla Elongata*, or in the noble Ventricle; and afterward, as much of it as not derived into the spinal Marrow and the Nerves of the brain, is preserved and retained in the whole brain, as in a Store-house.

The cover of the noble Ventricle is from the Brainlet.

The true place where Animal Spirits are generated according to our Author.

A Proof.

The preparation of the Animal Spirit where it is?

This Marrow | The Use of the lengthened and spinal
the beginning | Marrow, is to be the original of all the
of all Nerves. | Nerves. For from that part thereof
| within the Skull, those Nerves arise
| which are commonly attributed to the
Brain, being usually reckoned to be seven pair. But
from the longest part thereof which is in the Back-
bone, Anatomists do reckon thirty pair of Nerves to
arise, viz. as many as there are holes in the Verte-
brae.

Mean while we must not so understand the matter,
as though only so many branches or Cords did thence
arise. For every Nerve arises with many little strings
or Fibres, which going out at the hole of any Verte-
bra, are there joynted together by the Membranes, as
if the Nerve came out of one branch.

Chap. V. Of the Cerebellum Brainlet, Or Petty-Brain.

The Brainlet | The Brainlet being as it were a little
what it is? | and private kind of Brain, is a cer-
tain smaller portion, placed under the
Brain in the lower and after-part of the Occiput or
Minder-Head: In Brutes it takes up commonly the
whole Region of the Occiput.

It hath the same Substance, Consistency, Colour, Mo-
tion, &c. with the Brain.

Its Structure. | In the Turnings and Windings it
differs from the Brain. The brain
hath sundry Circumvolutions with
out any Method or Order: the Brainlet hath circular
and ordinate ones, stretched one over another
like Plates. They are differenced partly by interpo-
sed Vessels, partly by the pia mater, which being sepa-
rated, the several Circles may be taken out after ano-
ther.

The inner Substance is various, whiteish and Ash-
coloured, which distributed certain Vessels as it
were.

The Vessels interposed betwixt the several plates, are
carried through the pia mater like nets, which accord-
ing to the accurate Observation of Francis Sylvius, aris-
ing from the Branches of the Arteria cervicalis, do at
last end into the fourth Ventricle.

It is constituted chiefly of two lateral parts, on each
side making a Globe as it were.

It hath two Processes or Excrescences, termed *Vermi-
formis* or *Worm-like*, because they are variously orbicu-
lated, and consist of many transverse portions, coupled
with a thin Membrane. Their Extremity being thin
and convex, is as big as a small tare.

And they are situate at the seat of the noble Cavity,
one before, the other behind.

About the hinder-part of the Trunk of the Spinal
Marrow, in the Circumference of the noble Ventricle,
out of the same brainlet there proceed two other
globous processes, sometimes two of each side, some-
times three. Those are greatest which are

See Tab. 4. | seated by the Vermiformis, the rest are
Fig. 1. | smaller. *Varolius* calls it the bridg of the
brainlet.

The Use of all the Processes is to hinder the noble
Ventricle from being obstructed, by pressure of the
brainlet. *Laurentius* saies they help the motion of the
Ventricles like a Valve, because the Vermiformis be-
ing shortned opens the way, which goes from the third
to the fourth Ventricle; when it is extended it shuts

the Chink, least the Spirits should go back into the up-
per Cavities. *Riolanus* dissent but little from him,
for he will have it to open and shut the entrance of the
fourth Ventricle. But it is not moved of itself, be-
cause, as the brain, so is it void of any proper motion,
unless you assign it to the Vessels or pia Mater, which
are very small, or at least to the neighbouring Animal
Spirits.

Now I believe the use of the bridg is, to combine
and keep in compass the Circles of the brain, and as a
bulwark to defend the noble Ventricle. And therefore
it would more properly be called a Sconce or Fence,
then a bridg.

The Use of the brainlet is the same with | The Use.
that of the brain. But *Galen* would have
it to be the Original of the hard Nerves; which is
false. For no Nerves have their Original from it.

Chap. VI. Of the rest of the Parts observed in the Brain; viz. the Rete mirabile, Glandula pituitaria, Infundibulum, Ventricles of the Brain, Corpus callosum, Fornix, Plexus, Cho- roides, Glandula pinealis.

The precedent parts being considered, we must
come now to those things, which are presently
visible, about the Conjunction of the Optick Nerves,
such as are: the *Rete mirabile*, *Glandula pituitaria*, and
the *Infundibulum*.

The *Rete mirabile* or wonderful Net, | *Rete mirabile*
which some call *Plexus retiformis*, is so |
called by reason of its artificial and wonderful stru-
cture, for it shews like many Nets heaped together.
Now it hath another structure in Calves and Oxen,
in which Creatures it is also more manifestly discern-
able then in mankind, though we must not
say that it is not in Men as *Vesalius* doth, | *Vesalius*
though hard to discern. I remember ne- | *his Error.*
vertheles that it hath been wanting.

This Net lies under the Basis of the Brain, encom-
passes the Glandula, at the sides of the Cavity of *Os
Sphenoides*.

It consists (not of the Nerves of the third Conjug-
ation as *Volcherus* would have it, but) of the Carotick
and Cervical Arteries, carried up from the Heart, to
the Basis of the Brain, which convey blood and Spi-
rit in to this Net.

Riolanus places the *Rete mirabile* at the same Basis
of the Brain, viz. The off-spring of the *Plexus Cho-
roides*, which creeps through the former Venti-
cles.

The Use of this Net is, that therein the blood and
vital Spirit may be a very long time detained, that the
first preparation towards the Generation of Animal
Spirits may there be made. Also *Walaeus* hath obser-
ved that this Net doth consist of final twigs of the ju-
gular Veins; that they may doubtless carry back such
blood as is superfluous after the preparation of the
Animal Spirits.

The Glandula pituitaria or Rheum- | Glandula
ketal, is so called from its use, because it | pituitaria.
receives

Its Seat. receives the Excrements of the brain out of the Ventricles through the Funnel. And therefore it is placed at the end of the Funnel in the saddle of the *Sphenoides*. *Galen* calls it barely *Glandula*.

Its Figure. On the upper-side it is hollow, beneath bossie or bunching.

Its Substance. Its Substance is harder and more compact than that of other Kernels.

Its Use. It is clothed with the *Pia Mater*. Its Use is the same, with that of other Kernels, viz. by its drinking

spongy flesh to receive grosser Excrements (for the thin Vapor out at the Sutures) collected in the Ventricles of the brain, many times in great quantities. For the brain being of great bulk, did need much Aliment, and therefore it breeds many Excrements, especially when it is in any measure disordered. These Excrements the Kernel doth sometimes cast into the Palate of the Mouth, and sometimes suffers them to drain away by the holes in the basis of the Skull.

Others suppose the use of this Kernel to be, to shut the Funnel, lest the Animal Spirits should go forth. For just over the *Glandula Pituitaria* or Rheum-Kernel, is

Infundibulum or Funnel, so called from its shape, for above the Head thereof is large, the lower part is a long and strait pipe. Others call it *Pelon* the Bafin, which words doth more properly belong to the Head, or beginning of the Funnel then to the whole body thereof.

The Funnel therefore is an Orbicular Cavity (sometimes triangular with sharp or blunt Angels) made of the *pia Mater*, where it ingirts the basis of the brain. Its beginning is large, at the hole of the third Ventricle, as they call it; through which the Excrements are packt away out of the Ventricles into this Funnel.

Riolanus informs us that it hath four little pipes, which distil Rheum or Phlegmatick serum through the four holes resting upon the *Sella Sphenoides*. Its of a dark Colour, and if you open it you shall find it full of thick Flegm.

The FIGURE Explained.

The Fornix being removed the *Glandula Pinealis* is here to be seen as also the third Ventricle of the Brain, which is in the middle between the two foremore Ventricles.

- AA. The Brain cut smooth off through the middle.
- B. The Fornix took away and turned back.
- CC. Its Expansions or hinder Thighs.
- DDDD. The bottom of the right and left Ventricles, wherein the Vessels appear before.
- EE. Their Walls or Sides.
- F. The foremore hole of the third Ventricle, which some call Vulva.
- G. A chink denoting the third Ventricle.
- HH. Bunchings of the Brain called Nates, the Bunches.
- II. The Protuberances or bunchings called Testes the Stones.
- K. The *Glandula Pinealis* or Pine-kernel-prop'd *Glandula*.



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Two little whiteish Kernels or Portuberancies of the brain are placed before this passage, which are to be seen, the brain being turned upside down, there where the Funnel receives wheyish Excrements out of the Ventricles.

These things being thus handled, the Original of the Nerves follows in course the Section to be observed, which every where arise from the Marrow: of which I shall speak in our Manual of the Nerves.

Tut

The Ventricles or Cavities of the Brain do follow.

These according to the common manner of Section, beginning from above, are thought to be three: two foremore and uppermore as they call them, and one in the middle, to which some add a fourth, of which we spoke before.

But if dissection be made after the new manner, beginning from beneath; there appear only two, so that the third is common, being a portion of the other two.

The Authors opinion that there is but one Ventricle of the Brain.

I conceive that there is but one Ventricle of the brain, which is in the middle, but the beginning thereof is divided into two; or there are two processes, which receiving the Excrements, carry them into the middle itself, which they call the third. For there is one continued Cavity of the brain, and the two Ventricles so called, do end into a common Cavity.

Mean while, because this and that part of the Cavity seem diversly formed, some distinction may be allowed for Doctrins sake.

The foremore Ventricle described.

Those two Ventricles which are ill termed the foremore and uppermore (because they consist also in the hinder and lower part of the Brain, perhaps they might better be called the lateral Ventricles, and with Vesalius the right and left) are the largest of all, crooked, full of windings, Semicircular, and clothed with the pia Mater.

They are commonly and not unfitly liken'd to the Moon when she is in the Wane; although they are hardly ever demonstrated to be such in dissection. But seeing they are both oblong, and very large in their hinder part, they may also be likened to Horse-shoes. This round form of the Ventricles was first discovered by the most accurate *Fr. Sylvius*, and after him I have often demonstrated the same. But if you would find the true Figure, you must cut the brain deep towards the Skull, or the Temples, on each side, because it is deeply sunk into the *Corpus Callosum*. For that part of the Ventricles towards the *Septum lucidum* is higher, and that which is towards the lateral part of the Skull is lower. The foremore and deeper parts, are near to the Mammillary processes, and if we believe *Piccolominius*, *Baubyus*, *Riolanus*, they are in some manner transpassable, especially in elderly persons.

Moreover they run out in their hinder part by a straight Course, where they form a Cavity which is somewhat round, not unlike the Finger of a Glove; this I remember hath been sometimes wanting.

Moreover it is to be noted, that these Ventricles do environ the lateral and hind parts of the Roots of the Spinal Marrow, which also, under the *Plexus Choroideus*, a part of the brain being wreathed and attenuated inwards, and upwards making the Concavation of the Ventricles, doth embrace with a selvage as it were and a Fringe or lace, which the praise-worthy *Sylvius* wont so to call for likeness sake, it being knit to the was foresaid roots by exceeding thin threads. If gently lifting up the Plexus, you shall remove this lace from the Root, you shall find little Arteries creeping through the lower surface of the Ventricle, continued to the Net-like Coronet of little Arteries investing the root; by help of which, this Lace seems to stick more close to the Root.

But here you shall observe, that there is an easie

outgate for the Humors contained in the said Ventricles, which may descend down along the spinal Marrow.

They are therefore formed, not in the Brain, but in the marrow, where they call it *Corpus Callosum*, because the substance is there harder like a *Callus*, where the Ventricles seem to rest upon the two foremore Extuberancies.

The Conformation of the Ventricles of the brain, which all cannot easily discern, I have by Anatomical Inspection and the Guidance of *Sylvius*, learnt to be thus.

Two Roots of the Spinal Marrow do penetrate a good depth into the substance of the brain; to the upper and former whereof, especially where it looks inward, the brain being continued (now I mean the whiteish and Ash-coloured part by the term Brain) it spreads it self every way, especially outwards and backwards and by little and little wreathes and contracts its lower extremities inward and upwards, till at last being attenuated, it doth on all sides embrace the Root of the spinal Marrow with a lace, a little below the place where it springs therefrom, as was said before; and so forms the lateral Ventricles.

But in the foremore and inner part, and whiteish substance ascending from each Root, and making one body cal'd *Corpus Callosum*, it is carried back; and covering the middle distance between the Roots, which is the third Ventricle, and the wide mouths of the lateral Ventricles opened thereinto, framed by it self, it makes the *Fornix*, Arch or Vault; and is continued to the hinder and inner part of the Limbs or edge of each Ventricle.

Regius adds many pores in the Ventricles, looking into the Fiberkies of the substance of the brain, in which the Animal spirit is bred. But those pores and Fiberkies are invisible to the Eyes of Anatomists.

They are distinguished by a loose and wrinkled Partition-Skin: which if it be stretched out and held against the light,

it shines because of its transparency, and is therefore cal'd *Septum lucidum*: which some will have to spring from a most thin portion of the brain it self, others from the pia Mater doubled. But the former opinion is truer, which you may perceive, if after the manner of *Sylvius* having removed the brain and sickle of the other side, you shall search the Ventricle of the opposite part, and shall lift up that part of the brain which is continued with the *Corpus Callosum*, at the Orifice of the third ventricle; for then it may easily be seen, and discerned to be a small portion of the brain.

The lower, whiteish part, where the ventricles are joyned, is termed

Fornix, the Arch, or *Testuda* the Belly of a Lute, being of a Triangular Figure, consisting of three shanks, one before and two behind. In the common Method of Dissection, this body is supposed to be spread out over the third ventricle, and to lie beneath the *Corpus Callosum*.

Under the *Fornix* according to the observation of *Sylvius* the *Choroideus plexus* of both sides, is immediately carried, tending towards the *Glandula pinealis*; under which *Plexus*, in its upper part, the two Roots of the spinal Marrow grow together; so that here the *Testuda*, is not seated immediately under the third ventricle.

The FIGURE Explained.

This Figure presents the left Ventricle of the Brain, being bent back, as it is represented in the fifth Figure.

- a. The right Ear.
 b. The left Ear.
 cccc. The bone of the Forehead.
 dd. Part of the Skin of the Head hanging down on either side.
 eeeeeee. The dura Mater of both sides hanging down.
 ffffff. The Brain according to the passage of the left Ventricle, divided from that part which lies over the Root of the spinal Marrow, and turned backwards.
 gggg. Part of the Brain resting upon the spinal Marrow.
 hh. A great chink of the Brain going over the Root.
 iiiiii. The inner face and form of the left Ventricle resembling the sharp corner'd Moon.
 k. The Cavity of the Ventricle like a Glove-finger.
 l. An orifice going into the third Ventricle.
 mmm. The lace sticking to the Root of the spinal Marrow.
 nn. The lace removed from the said Root.
 ooo. The Plexus Choroides.
 ppp. The Root of the spinal Marrow raised up.

The VI. TABLE.



- qqq. Vessels creeping up and down the inner surface of the Ventricle, and springing for a great part, from the final Arteries which compass the Root.
 r. The Septum lucidum.

The third Ventricle. The third Ventricle commonly so called, or the long Chink, is the meeting together of the Ventricles aforesaid, which is formed in the Centre, as it were of the Marrow of the Brain, by reason of the Conjunction of two round Trunks proceeding out of the Brain. It hath in it two passages, the first foremost, going downwards to the Glandula pituitaria, that it may there void its Excrements: the other is hindermore, cloathed with a Membrane; which hole some call *Anus*, the Fundament; it goes beneath the Buttocks to the noble Ventricle, that the prepared matter of the Animal spirits, may pass into the place and Womb as it were of their Generation.

The Anus, what it is? This hole is nothing else but a space arising upon the mutual contact of the four Trunks of the spinal Marrow,

The Nates and Testes. Now the Nates or Buttocks, and the Testes or Stones are four Orbicular prominences, which they say are in the Brain, which is false. They call the two portions of the Roots of the Medulla oblongata, which arise from the Brainlet, Nates; and those two little ones of the Roots from the Brain, they call Testes. And these parts are lower, the other upper.

These differences, as *Fr. Sylvius* notes, between the Testes and the Nates, have place in Brutes rather than in Men; for the Men they are commonly equal, and many times the Testes are the bigger.

But it is a trifling peice of business to impose such Names as these; as also when they call the *Glandula pinealis*, *Penis*, and a certain long ditch between the Eminences they term *Vulva*.

Between the fore-more Ventricles so called, and the Seat of the Testudo, there is, the Plexus Choroidis or Reticularis so called, being a contexture of very small Veins and Arteries, sent partly from the Arteries, partly from the Vessels of the dura Mater into the fourth Ventricle. There is a glandulous substance interwoven within this Plexus, and a portion of the pia Mater. The Plexus Choroideus being truly glandulous, does receive a little branch of the Carotick artery, which pierces into the lower part of the brain, which ends about the Glandula pinealis, where it branches up and down through the lower Surface of the Ventricle.

The Use hereof is the same with that of the Rete mirabile.

At the beginning of that hole, which passes from the middle Ventricle into the noble Ventricle, there is placed a certain Glandule or Kernel, termed *Pinealis*: the Pine-kernel Glandule, because it is fashioned like the Kernel of a Pine-apple. The Greeks call it *conarion* or *soma choroides*, some term it the Yard of the brain.

Penis.
Vulva.

The Plexus Choroidis, what?

Glandula pinealis.

It is of an hard substance, of a yellowish and sometimes dark colour, and is covered with a thin Membrane. In Creatures newly kil'd tis large, in old karcasses, being melted it is scarce apparent, or is very small, as also in men, whose brains cannot be opened whilst they are warm. And therefore they say it spends like Camphire expos'd to the air, being also partly melted, as Salt is in a moist place.

According to the Observation of *Sylvius a nervosis little string* does fasten this Kernel as it stands betwixt the Testes.

Who also observed more then once certain granes of sand in this Kernel, and sometimes also a little stone as big as the fourth part of a pease, and somewhat round.

The Use of this Pine-kernel is like that of other kernels, and especially to help the distribution of Vessels through the brain. Some will have it placed like a Valve before the hole which passes into the fourth Ventricle.

Dei Cartes and his Followers *Meysnerius, Regius, Nogelandius*, do conceive that this Kernel being placed in the middle of the Ventricles, which when a man is awake are distended with Spirits perpetually, does 1. Receive the motions of all Objects. 2. That the Soul in this part alone by these motions, does apprehend all external sensible Objects, and all the Ideas proceeding from the five Senses, as in a Centre, and discern the same, and does afterward by help thereof send Spirits into all parts; as in a final Spherical glass all things are received in the same order in which they are either in a Field or Chamber.

For this cause *Meysnerius* will have it to be of a conick Figure, because Individuals require more space then sorts or kinds of things. And that these Ideas are diversly moved by the motion of the animal spirit, but are alwaies found joyned by the Verb EST, and according to their equality or inequality, truth or falsehood is compounded, being compared together like two Lines.

And that for this cause Infants do not presently speak nor reason, because the flappiness of their brain gives not passage to the Idea's. And that the overgreat and confused motion of these Idea's in the Pine-shap'd kernel, makes ravenings, as in persons drunk, phrentick, &c.

But many things there are which will not suffer me to embrace this new and witty Opinion. For

1. It is too small and obscure a body, to be able to represent clearly the Species of all things.

2. The Species of all Senses do not come hither, because the Nerves do not touch the Kernel.

3. It is placed in the Quarter of Excrements, whether they are purged out, by the third, and two foremore Ventricles, where the Species or Representations of things would be defiled.

4. The Species of things are perceived rather there whereto they are carried. But every sensory Nerve each in its place carries the Species to the beginning of the spinal Marrow, and therefore each in their place are judg'd and received by the Soul, in the beginning of the spinal Marrow. Moreover this Marrow is big enough, globous, hard, and of a brighter colour.

5. Several Idea's would be confounded in this little body. The Eye indeed being likewise very small, receives the Species or Representations of things without Confusion, but they are only the visible Species; whereas in this Kernel the divers Species of different Senses are to be received.

6. There is hence no open or known passage to the

Nerves, as from the beginning of the Marrow, nor any communion with some Nerves of the external senses.

The Use of the Cavities or Ventricles of the brain is, to be the Receptacles of Excrements, which is apparent.

1. From their Structure: for an hole goes from the Cavities to the Glandula pituitaria.

2. The Surface of the Ventricles is continually moistned with a watry Humor.

3. They are often found topful of flegm and watry moisture.

Howbeit in this new Section after the neck of the funnel is shewed with the Glandula: the Marrow being lifted up, first of all the Nates and the Testes are seen, and then the hole into the noble Ventricle; afterwards divers Nerves, the Ventricles of the brain with the hole into the funnel the Corpus callosum, the Fornix, the Plexus Chorooides, and the Glandula pinealis.

But in the old and common way of Dissection, these parts of the brain are shewed in order: The Corpus callosum, the Septum tenue, the two Extuberances, upon which the Ventricles rest; the two Ventricles, commonly called the foremore; the Fornix, the Plexus Chorooides, the third Ventricle, its two holes, the Glandula pinealis; and the brainlet being a little removed, the Nates and Testes the brainlet, the worm-fashion'd Procceses, the noble Ventricle, the Pelvis, Glandula pituitaria, and Rete mirabile.

But if you will use the middle way of Dissection, familiar to *Fr. Sylvius*, thus you shall proceed. Take off the Skull as deep as conveniently you can. Then suffering the left side of the brain to remain untouched, with its Membrane; begin your Dissection on the right side, first of all cutting asunder and removing the dura Mater; then take away some particles of the brain with the pia Mater, til you come to the Cavity of the Ventricle, and then follow both its upper and lower passage with your Dissection, as you see it done in the second Table. Separate the Limbus if you please, with a blunt probe, from the root of the Spinal Marrow, and shew it; though that may be more conveniently done in the opposite side of the Brain. The greatest part of the right side of the Brain being thus taken away, the upper and lower Cavities of the Sickle are to be shewn, as also the greater right side lateral Cavity, and the oblique descend of the upper Cavity thereinto, all which you have expressed in the foresaid Table.

These things being thus done, go to the left side, and therein first cut asunder the dura Mater, and remove it with the Falx or Sickle; then gently remove the left side of the Brain, into the place of the right side newly removed; and as you are doing this observe from Tab. 3. the Vessels going into the lateral Cavity, and how they rise up about the optick nerves, and are distributed into very many branches, creeping every where up and down the inner Substance of the brain, and especially the winding Surface thereof, til at last they end into the Carotick Arteries. Then search out that same notable chink or cliff, between the windings,

That the Ventricles of the Brain serve to receive Excrements.

The order of the parts to be shewn in the new way of Dissection.

The order of the parts in the old Dissection.

The order in the middle way of Dissection.

The Dissection of the right side.

The Dissection of the left side.

dings, which is figured out in the Table aforesaid; and having cut the pia Mater, open the sides thereof a little with a *Spatter*, that the branches of the Carotides may better appear, which are carried through the bottom of the turnings, with the Rudiments of new

An excellent
Argument
for the Cir-
culation of
the Blood.

windings. But if, before you shall begin to shew the brain, you shall free the Carotick Arteries and the jugular Veins from the parts adjacent in the Neck, and bind them distinctly; and then by a Wound made in an Artery shall put in a crooked hollow probe and blow; the vessels diffeminated through the whole brain will swell, as being branches of the Carotick Arteries, until the air with the forced blood shall at length empty it self into the Ventricles: if by the foresaid hollow probe, you shall in like manner blow into the Ventricles, you will perceive their continuation and communion with the jugular Veins, by the swelling and distention of the said Veins; and will acknowledg that the Circulation of the blood, is not a little confirmed by this pleasant Spectacle.

Hence, returning to a farther search into the fabrick of the brain, and a wary Incision being made in the hinder part of the side propounded, search there for the larger Cavity of the Ventricle, and follow it with your Dissection to both the Ends; then turn back every way the outer part of that which is dissected, the middle part being kept upright, which rests upon the root of the Spinal Marrow, and is continued therewith, which is excellently well expressed in Table the sixt, in the Explication whereof, what you see set down, weigh in order.

Finally, taking away the Brain, observe again all the Cavities and that more distinctly; and then when you have seen the third Ventricle, the Funnel, the Glandula pituitaria, the pates of Nerves, after the usual manner; go back again to the Penis, Anus, Testes, Nates, &c. and examine the brainlet and its parts.

Nor will it be unprofitable, as often as a new occasion of Dissection is offered, so often to change the section in some part; for so it will come to pass, that you will alwaies observe somewhat which was unobserved before, or neglected, or not distinctly enough considered.

Chap. VII. Touching the Forehead.

Why Mens Face is void of Hair? The Hairy part of the Head being explained, the smooth part or FACE follows, which in man is void of Hairs, otherwise then it is in Beasts, for Beauties sake; it is also called *Vultus* because of the judgment of the wil, which is Conspicuous of the Face.

Frons why so called? The upper part thereof, viz. the Forehead is termed *Frons* a ferendo from carrying, as some conceive, because it carries in it tokens of the mind: the rest thereof, from the Eye-brows to the Chins end, is the lower part, in which are many other parts, which are hereafter to be explained in order, external and internal, the Organs of the Senses, Muscles of the Eyes, Nose, Lips, &c.

Its Skin. The Skin of the Forehead, because it is moved, therefore it hath Muscles, which *Platerus* terms the signifiers of the Affections of the Mind. Now the Muscles of the

Forehead do lift up the Eye-brows, and are thickest at the said Eye-brows.

They arise from the Skull, near the coronal Suture, and are knit at the sides to the temporal Muscles, but in the middle they are distinguished a little above, but beneath they are so nearly affociated, that they seem to be one Muscle, and end at the Eye-brows. Yet I have observed in a large nosed person, that an Appendix of the said Muscles did reach to the Gristles of the Nose.

They have straight Fibres. Surgeons therefore must not cut them athwart, least they destroy the lifting up of the Eye-brows; but upwards, according to their length. *Hofman* after *Aquapendent* stands for oblique fibres, on the right side from the right hand to the left, on the left side from the left hand to the right. But this they do against Experience, ocular Inspection, and Reason. For the skin of the Forehead is by a straight course, either elevated or depressed by help of right fibres, which are the cause of straight motion. In the point of right fibres, we have the Consent of great Anatomists *Vesalius, Laurentius, Bauhinus, Platerus, Veslingius*, &c.

And because the skin of the Forehead grows close to these Muscles, therefore both the Forehead and the Eye-brows are moved.

Howbeit there are sometimes also two Muscles in the hinder part of the Head, which move the skin thereof, short, thin and broad, with straight fibres, ending above into a broad Tendon, and touching the hinder more Muscles of the Ears, in their sides. Some men that are furnished with these Muscles, can draw the skin of their Heads backwards.

Chap. VIII. Of the Eyes.

The Eyes are termed *Oculi* ab *occul-tando* or *occludendo* from shutting or hiding, because they are hid under the Eye-lids; they are the Instruments of Sight made of Humors, Membranes, Muscles, Vessels, and other Parts.

They are seated in an eminent place like Watch-men, in boney Sockets covered with the Periostium for better Safeguards sake.

They are in Number two, for the perfection of Sight, and that one being defective, the other may supply its place and office. Howbeit both Eyes see but one Object, at one and the same time, and not a double one, whether because the knowing and judging Faculty is one, as *Aquapendent* conceives, or because the Axle-tree of the two visual Pyramides, do pass along upon the same Surface of a plane, as *Galen* expounds the matter; or because of the exact similitude they have received from particular things from whence they came, the internal sense judging only one and the same species; as *Aquilomini* does philosophize. They are in Mankind very little distant one from another, both for the Nobility and perfection of their Action, and the Reception of visible species.

They are round; but a little longish, like bulbous Roots whereupon

Two Angles or Corners are made, at the Socket of the Eyes, which are termed *Canthi*; the inner and greater at the Nose, the outer and lesser at the Temples,

The Eyes why called Oculi?

Their Situation.

Their Number.

Their Shape.

Its Parts. In and about the Eye, there are sundry parts, some without the Eye, for safeguard or commodities sake, as the *Eye-lids* with their *Hair* and the *Eye-brows*, also *Caruncles* in the *Corners* of the *Eyes*; other parts there are which constitute the Eye it self, and they are *Fat*, *Muscles*, *Membranes* and *Humors*.

The Eye-lids. *Palpebrae* the *Eye-lids* are parts which cover and shut the Eye, which cleanse and putrifie the *Cornea Tunica*, and likewise by their overshadowing render the *Picture* in the *Retina* more illustrious, according to the opinion of *Averrhoes*, *Varolius*, *Plempius*.

The are made up of the *Skin*, the *Membrana carnossa*, *Muscles*, a *Coat*, the *Tarsi* and *Hairs*: and therefore their substance is soft,

Whether the lower Eye-lid be moved? The *Eye-lid*, is either the *lower* which if we believe *Galen*, is of it self immovable, save in some birds. Yet *Baubin* and *Aqua-pendens* do aver that they are really moved, and *Fallopins* proves it

by the example of a *Sea-Calf*, and any one may prove the same in a *Looking-glass*, wherein he may see his lower *Eye-lid* meet the upper. But either this motion is obscure or we must say with *Vesalius* and *Sylvius* that the upper part of the circular *Muscle* doth lift up the upper part of the *Eye-lid*, and that the lower part is drawn down, by the other part of the *Muscle*, which notwithstanding is not true, because the straight *Muscle* lift up; or we must say with *Piccolbomineus* that they follow the motion of the *Cheeks*; or finally, the *Orbicular Muscles* only moves the upper *Eye-lid*, and doth but embrace the lower, and knit it is a coupler. The other is the *upper*, which is moved and that most swiftly. so that we compare a quick motion to the twinkling of the *Eye*.

Now they are moved upwards, that is to say are opened and lifted up by the *right Muscle* which is less then the other. It arises about the *Optick Nerve*, and ends with a *Tendon* into the *Extremities* of the *Eye-lid*. They are moved downwards, that is

The Muscles of the Eye-lids.

The Explication of the FIGURES.

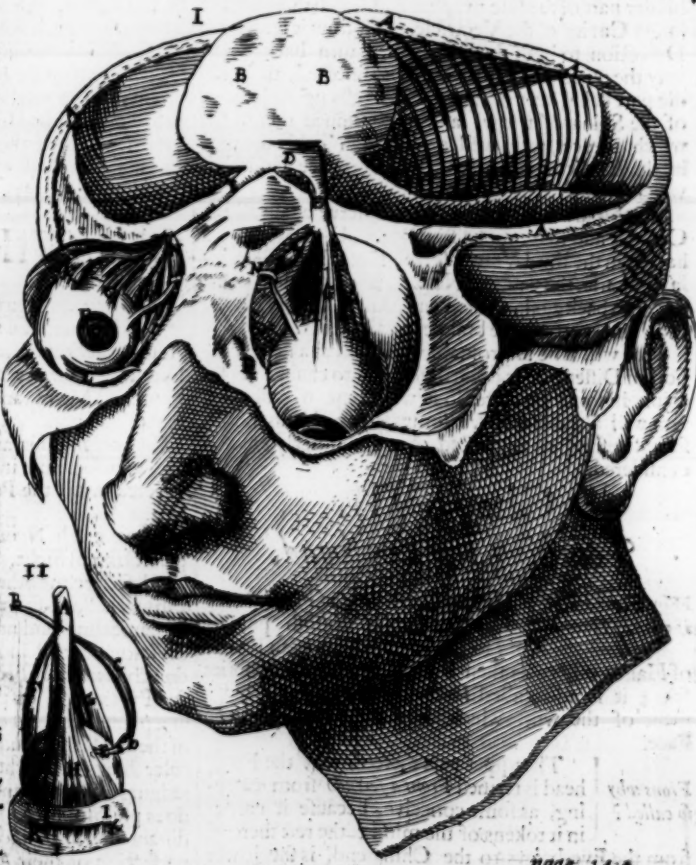
This TABLE represents the *Muscles* of the *Eye* in their natural Situation, and the *Muscle* of the *Eye-lid* by it self.

The VII. TABLE.

- FIG. I.
- AAAA. The hollow part of the Skull cut off.
- BB. The inner and whitest portion of the Brain dissected.
- CC. The Brainlet or Cerebellum.
- D. The meeting and union of the Optick Nerves.
- EE. The parting of the said Nerves going to each Eye.
- F. The Caruncula Lachrymalis drawn out of its place.
- GG. The first Muscle of the Eye called Attollens.
- H. In the right Eye, shews the second Eye-muscle, or the Musculus deprimens.
- II. In both Eyes shews the Musculi recti interni or Adductentes.
- KK. In each Eye shews the recti externi or Abducentes.
- L. The Musculus quintus, or obliquus externus, is shewed in the right Eye.
- MM. The sixth Muscle or the obliquus, internus, whose Tendon passes through the Pulley, N.
- O. Shews the optick Nerve in the right Eye.
- P. The Cornea Tunica, in the midst whereof is the Pupilla.

FIG. II.

- A. The optick Nerve.
- B. The Nerves which moves the Eye.
- C. The Trochlearis Musculus, whose Tendon, E, goes



- through the Pulley, D.
- F.G. The Musculi recti, internal and external.
- H. The Muscle proper to the upper Eye-lid, contained within the Socket of the Eye.
- III. The Eye-lids cut out off.
- KK. The Cilia, that is the Ends of the Eye-lids adorned with Hair.

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so say are shut and covered, by a certain Orbicular or Circular Muscle, which is every way half a Fingers breadth, arising from the Root of the Nose, which afterwards runs back with circular Fibres, under the lower Eye-lid, through the outward corner, and ends above the upper Eye-lid, at the same place of the inner corner. *Spigelius* and others do divide it into the upper and lower Muscle, because each hath a different Nerve coming from divers places, and they observed that in the *Convulsio canina* so called, sometime the lower Eye-lid was stiff, the upper being moveable. But no division of this Muscle can be discerned by the sharpest Eye-sight, the Fibres being every where continued, though the insertion of the Nerves be different as it is in some other Muscles, of the Nose &c.

The Membranes. The *Membrana carnea* is thin in this place, together with the Muscles, like another simple thin Membrane; and therefore *Aristotle* said that the Skin of the Eye-lid was without flesh, and being cut off, like the Fore-skin, it grows not again.

They are clothed with an inner Coat springing from the Pericranium, exceeding thin and soft, least they should hurt the Eyes, which they touch.

The Extremities of the Eye-lids are hard and Gristley; but soft like smal Gristles, and Semicircular, the Greeks term them *Tarsus*, the Latins *Cilia* whereon the Hairs are fastned (which some term *Cilia*) being straight because situate in an hard place, keeping all waies in a manner the same greatnes hindering smal and light matters from falling into the Eye, and serving to direct the sight which *Galen* proves from such as have them fallen or pulled off, who can hardly discern things afar off, especially if they be of a dark colour, which *Montanus* doth prove by the example of a youth at *Lisbon*.

The use of the Eye-brow. The *SUPERCILIA* or Eye-brows, are Hairs growing at the bottom of the Forehead, above the Eyes, intercepting such things, as fall from the Head that they may not light into the Eyes.

Caruncula a smal portion of flesh, is placed at each great corner of the Eye, containing Humor to moisten the Eye: and it is placed over an hole bored in the Nose-bone, which is called *Punctum lachrymale* (distinct from these two holes in the edge of the Eye-lids, which *Galen* call *Tremata*, and are most visible in living bodies, especially of such as are inclined to weeping) least we should continually weep. But in an Oxe there is moreover a moveable Membrane, which can shut the Eye, though the Eye-lid be open, by help whereof Brutes wink and cover their Eyes, when they fear any thing should fall into or hit them.

The use of fat in the Eye. In the spaces between the muscles and sundry Vessels, there is fat, which heats, moistens, and so helps the motion of the Eye, and makes it round and even.

The Eye muscles. The MUSCLES of Mens Eyes are six. Because they have so many distinct motions: four straight and two circular: all are seated within the Cavity of the Skul, and accompany the optick Nerve. All their Tendons being joyned together at the *tunica Cornea*, under the *Adnata*, do

Columbus his Error. make that Coat which *Columbus* call *Tunica innominata*, the *Nomelesi* coat, as if it had not been known to the ancients,

whereas *Galen* hath made mention thereof, in his tenth Book de *Ufu partium* Chap. 2. & 8. though it be not properly a Coat, but only divers Tendons of Muscles, nor doth it compass the whole Eye. Yet by some it is called *Tunica Tendinosa* or *Tendinea*, the *Tendinous Coat*.

The first Muscle being the upper and thicker is called *Atrollens* the lifter up or *Superbus*, the proud Muscle.

The second opposite to the other, being the smaller in the lower part, is termed *Deprimens* the depresser, and *Musculus humilis* the lowly Muscle, because it draws the Eye downwards towards the Cheek-balls.

The third placed in the greater Angle is called *Adducens*, the drawer to, and *Bibitorius* the drinking Muscle, moving the Eye inwards towards the Nose.

The fourth is called *Abducens* the drawer from, drawing the Eye towards the side of the Face to the smal cornerward; tis also termed *Indignatorius* the Muscle of indignation.

All these four Muscles have the same beginning, the same progress and end: for the beginning of them all is acute, near the hole where the optick Nerve enters into the Socket of the Eye, from the Membrane whereof they do arise: they have all a fleshy and round belly: their end is a very smal Tendon, as was said, at the Cornea.

By these four acting together the Eye is drawn inwards, and is kept from flurring, which holding is by Physicians called *Motus tonicus*.

The fifth is lean, round, short, *obliquus*, seated between the Eyes and the Tendons of the second and third Muscle, and ascending by the outer corner of the Eye, to the upper part of the Eye, is inserted into the *Cornea tunica* by the Region of the Iris. It whirls about the Eye obliquely downwards to the external Angle, or corner.

The sixth being the smallest of all, and having the longest Tendon, wheels the Eye about unto the inner Corner. For arising from a common beginning with the first four, it is carried right out to the inner Corner; there it passes through the Pulley, and ascends in a right Angle to that place where the fifth was inserted. Tis called *Trochlea Musculus* the Pulley-muscle, because it wheeled about as it were through a Pulley which Pulley is a Gristle in the Eye sticking out, first observed by *Fallopins*, though *Riolanus* do also attribute the Invention thereof to *Rondeletius* who lived at the same time with him. Tis situate at the upper Jaw-bone; by the inner corner of the Eye, and therefore in the Cure of *Fistula lachrymalis*, the Surgeons ought to have a great care, least they wrong this Pulley.

These two last are termed *Amatorij*, love Muscles, and *Circumactores*, rowling Muscles the upper and lower. For by the help of these Muscles lovers cast Sheeps Eyes one at another.

There is yet a seventh Muscle in Brutes, which may be divided into two, three, or four.

This is a short Muscle, compassing the optick Nerve, fat coming between, and being fleshy it is inserted into an hard Coat.

Its Use is; to hold up the Eyes of Brutes which look down towards the Ground, and to enwrap the soft optick Nerve.

An eighth membranous Muscle may be added, where-with Brutes do wink.

The first Muscle of the Eye.

The second

The third.

The fourth.

The fifth.

The sixth or pulley Muscle.

A seventh Muscle in Brutes.

Some Animals have no Muscles. *Sealiger* proved it by Dissection in Cats, yet *Casseri* pictures out the Muscle of a Cats Eye. A *Chameleon* indeed hath no Muscles, and yet moves his Eyes every way, and either of them backwards, and that by a wrinkled membrane furnish with Fibres, as *Panarolus* does aver.

Vessels of the Eye. *Vessels* are sent to the Eye, a *Vein* from the Jugulars, an *Artery* from the Caroticks, diffeminated through the Muscles, Fat, and Membrane.

The Nerves. The Eyes have the two first pair of Nerves, as they are commonly reckoned: The first is the *Optrick* or *seeing* pair being thick and porous, carrying from the Brain the Faculty of seeing with the Spirit, or carrying the visible Representations of things to the Brain. It is inserted behind, into the Centre of the *Tunica cornea*, to which from the hard *Tunicle* or external Membrane it communicates a Coat, and passes more inward to the Centre of the *Retina*, into which its marrowy substance is spread abroad; and sometimes a portion of the vitrea tunica, sticks to the inner part of the Marrow. In Brutes it is inserted obliquely, and not into the Centre of the cornea tunica, but into the side. The second is the *Moving* pair, which goes into the Membranes, and sends a little Branch into every muscle. But touching these Nerves I shall discourse more largely in my Manual of the Nerves.

The Membranes of the Eyes but three. The Membranes besides the external and the conjunctive (which is common) are but three and the *Humors* three. And as in a Nerve, there is a threefold substance which enters the Eye: so these three substances do make the three Coats of the Eye. For the first Coat arises from the dura Mater; the second from the pia Mater; the third from the marrowy substance in the Brain.

Adnata Tunica. The *Tunica adnata alba* or *conjunctiva* is smooth and thin, arising from the Pericranium. Some will have it arise from the Periosteum, and end at the Circle of the Iris, after it hath communicated a Coat to the Eyelid. It is the outmost Coat of all, next the bone. *Hippocrates* calls it the White of the Eye.

Its Use. It fastens the Eye to the Socket and inner Bones like a Ligament. It is of exquisite Sense.

The Seat of the Ophthalmia or Blearey'dness. It is sprinkled about with very many little Veins and Arteries, not appearing save when there is an Afflux of Humors, for then they swell and are very red as in the Ophthalmia or Blearey'd soreness, which Disease is seated in the Part.

1. Tunicle of the Eye. This Adnata being removed, the first that offers it self, is the *Sclerotica* or *dura* so called, which arises from the dura Mater, and it is thick, stretched, equal, and dark on the back part. The forepart of this they call *tunica Cornea*, because it is polished and transparent like an horn: for it may be scaled into four plates, over which the Epidermis is placed, and involves the whole forepart of the Eye. It is next the sclerotica or dura, firmly cleaving in the hinder part of the *Choroides*, yet joyned with the Chrystalline in the middle, that it may separate the watry and glassie Humors.

2. Tunicle of the Eye. The second is called *Choroides*, because it is like the Chorion, and Vessels are sprinkled up and down. It arises from pia Mater, being from the first Original

blackish, especially within, that the Idea's received in a dark place, might be the more illustrious. In Brutes it is of several Colours, sometimes watchet, &c. Under the transparent Cornea it is in men sometimes skie-colour'd, sometimes blew, or grey, which Colours are seen through the Cornea. This in its forepart is termed *Uvea*, by reason it is of the colour of a Grape, in which part it is thick and doubled: it is moveable and according to the diversity of the Object or Light, it is contracted and dilated, as we may very well discern in Cats. This forepart is also perforated in the middle, to let in the Species or Representations of visible Objects, where

The *Pupilla* or sight of the Eye is formed, which in Mankind is round: in some Brutes of an oblong shape, or long and round. *Riolanus* hath observed the compass of this hole or the Crown thereof, being drawn with the point of a Penknife, to have been cut off orbicularly, which may better be seen in an Ox eye boyled, which makes him think this Circumference to be a distinct Membrane from the Uvea, since it hath peculiar fibres. But this is confuted by *Plempius*, and because the Verge of the uvea tunica hath divers colours, hence arises

The *Iris* or Circle, which *Galen*, *Casseri*, *Riolanus* reckon to be sixfold, and *Plempius* but threefold: a double narrow one at the White of the Eye, a third at the Sight true and larger, illustrated with a constant colour. This Circle is seen variously coloured, and where it makes the Iris, it is sometimes skie-coloured, otherwhiles fierie, grey, black, &c.

From the Circumference of the Uvea, where its duplicated Membrane bends it self back to the Chrystalline, there arises a Ligament or *Interstitium ciliare* so called, which are certain then filaments produced out of the Uvea representing the black Lines of the Eye-lids, like Hairs, and they compass the Chrystalline humor, which by help of these is knit to the neighboring parts: it is moved with the Uvea being moveable. *Cartesius* will have its use to be to move the Chrystalline, that the Situation thereof may be changed, according to the various necessity of sight.

The third is the *Retina* or *Amphiblestroides* as the Greeks call it, that is the Net-fashion'd Coat, made of the inner substance of the Brain or of some Nerve spread out as it were, the pia Mater withal accompanying in the same, if we believe *Galen* and *Casseri*. Therefore this soft, and as it were snotty matter may be gathered together, compassing the vitreous Humor and its vitreous Coat like a Net. It is an exceeding thin coat, but more dark then lightsom, mixt with an obscure Redness, because the Species received, are here stopped and represented; yet is it a little snotty, with which Snot is sometimes white, for the illustration of the Species received. In my Judgment, it is the sliminess of the marrowy Substance.

Its Figure is femicircular, like a Mitre, and its sides are near the Chrystalline, for the distinct Representation of the Species.

Platerus saies it hath no Vessels; contrary to *Galen*, *Casseri*, *Sylvius* and others, and Experience it self: for the hinder part of the Choroides and the sclerotica tunica, have Vessels manifestly apparent in this Coat, and there they ought to be, that it may be nourished with its contents. This compassing yet farther becomes the *Aranea* or Chrystalloides, the proper Tunicle of the Chrystalline Humor, cloathing the fore and hinder part thereof, white, most thin and transparent, so that it is call'd the *Look-Iadd*

**The Explication of
the FIGURE.
The TABLE shews
the Muscles of the
Eye, the Tunicles and
the Humors.**

FIG. 1.

- A. The *horny tumicle* with the *Pupilla* or *fight* to be seen through it.
- B. The *right Muscle* that *lifteth* up the *Eye*.
- C. The *internal right Muscle* or the *Muscle* drawing to, or shutting.
- D. The *right internal Muscle* or the drawing from, or opening.
- E. The *right external* or opening *Muscle*.
- F. The *internal crooked Muscle* called *Trochlearis*.
- G. The *external oblique Muscle* below.

FIG. II. Shews the Muscles in a Sheeps Eye.

- A.** The Optrick Nerves.
BB. The seventh Muscle that is about the Optrick Nerve proper to Beasts.
CCCC. The straight Muscles.
D. The trochlear Muscle.
E. The lowest oblique Muscle.

FIG. III.

- aa. The adnata tunicle in its place.
- bb. The Cornea or horny tunicle.
- cc. The uvea tunicle.
- dd. The tunicle Sclerotic.
- ee. The hard Membrane of the Optick Nerve.
- ff. The tunicle Choroides.
- gg. The thin Membrana of the Optick Nerve.
- hh. The Net-tunicle called Retina.
- ii. The marrowy Substance of the Optick Nerve.

- l. The inward Marrow affixed
to the Vitrea.
mm. The Chrystal tunicle.
nn. The Pupilla.
oo. The shining part of the Cornea.
A. The watry Humor.
B. The Chrystalline Humor.
C. The plastic Humor.

FIG. IV. The adnata Tunicle separated from its place, with many Veins and Arteries.

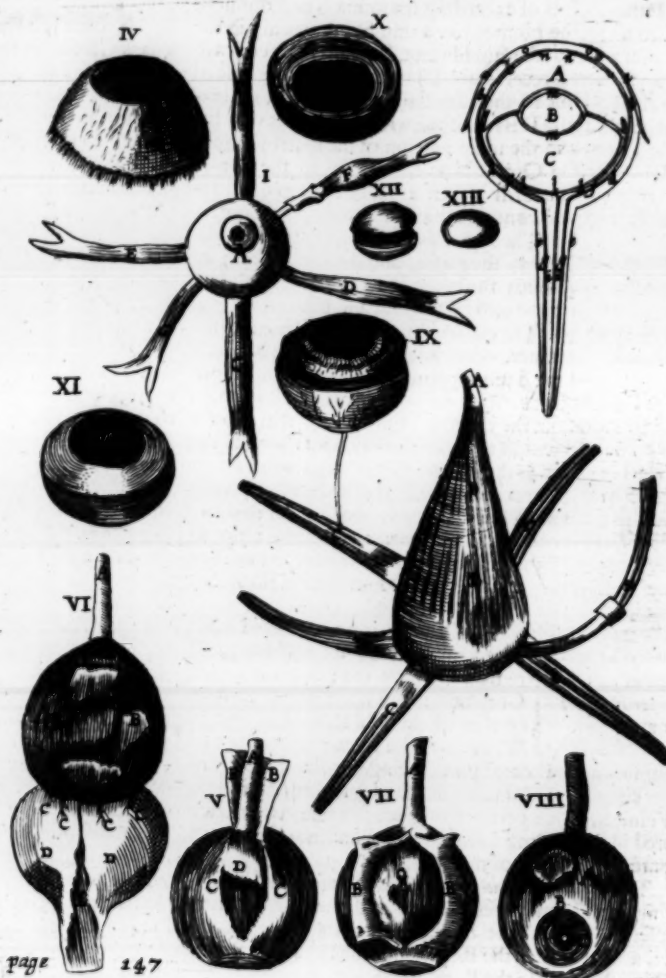
FIG. V.

- A. The Nerve Optick taken from the dura Mater.
BB. The dura Mater going about the Optick Nerve.
CC. The Sclerotic opened, through which the Uvea is seen.
FIG. VI.
A. The Optick Nerve covered only with the pia Mater.
BB. The Choroides taken from the Sclerotic.
CCCC. The Veins of the Sclerotic.
DD. The Sclerotic turned inside out.
EE. The Rupture of the Sclerotic.

FIG. VII.

- A. The Nervus Optick.

The VIII. TABLE.



- BB. The Uvea unfolded and separated in part from the Retina.
CC. Part of the Retina laid bare from the Uvea, made too obscure.

FIG. VIII.

- A. The Retina laid bare.
BB. The White of the Eye or tunica conjunctiva.
C. The Cornea.
D. The Pupilla.

FIG. IX.

The glassie tunicles with the Hairs of the Eye-lids.

FIG. X.

The watry Humor thickned in the middle of which there is a hollow to receive the forepart of the Crystalline.

FIG. XI.

The glassie Humor with the Crystalline in the middle.

FIG. XII.

The Crystalline tunicle.

FIG. XIII.

The Crystalline Humor in its proportion.

Vitrea. I add the *tunica Vitrea*, which covers the vitreous or glassie Humor on all sides, that it run not about, and separates it from the Chrystalline Humor. It is of exceeding smoothness and thinness, shed about the Humor like a thin Skin, not only in the convex part of the said Humor, but also in its concave part, where it receives the Chrystalline, where indeed it cleaves close to the Chrystalline Coat, but is different from it. It is furnished with many, but very little Veins, and the inner portion of the marrowy Substance of the Optick Nerve, cleaves to the Centre thereof. The form is such as that of the glassie Humor, large and convex behind, and concave before.

Humors of the Eyes. The Humors of the Eyes are three, the watry, the glassie, and the Chrystalline: of which the last is the most noble, and by some termed the Soul and Centre of the eyes.

The watry Humor. The watry because thin and fluxive like water, occupies the whole space between the Tunica cornea, and the fore part of the Chrystalline. *Riolanus* also proves that it is poured round about the vitreous Humor, and that all of it is contained within the whole *veea tunica*; because the Eye being cut in the hinder part, water flows out as much as if it were cut before. But if the *vitrea tunica* be also cut with a large Wound, no wonder if water flow from thence, which *Plempius* also notes; not to say how easily the inner parts are broken, when they are rudely fingered. In the Humor Suffusions are made.

The watry Humor is no animated part, the other Humors are. This Humor is no animated part, but seems only to be an Excrement remaining after the Nutrition of the Chrystalline Humor: for it is both consumed in Diseases, and lost in Wounds of the Eyes; the other two humors are animated parts, seeing they have their proper circumscription, are nourished with blood brought Veinlets, when perished they are not restored, and are bred in the Womb: and the Chrystalline of the most pure lightful part of the Seed.

The Use of the watry Humor is to defend the bordering parts from driness: others add, that as a medium it serves to break the brightness continually flowing in, and to greaten the Representations of the Objects, being strained in the Pupilla or Sight.

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The vitreous or glassie humor. The Vitreous or glassie Humor is seen behind, like molten Glasse, softer then the Chrystalline, then which it is nevertheless five times bigger, and twice as big as the watry Humor. It is round in its hinder part, plane before, but being concave in the middle, it makes an hollowness wherein the Chrystalline Humor is placed as in a Pillow. Its Use is not barely to nourish the Chrystalline, as *Galen* conceived, but to prepare and communicate Nourishment thereto. According to *Aquapendent* from whom *Riolanus* had the notion, that the light carried beyond the chrystalline may not return defiled by dark and other coloured tinctures, and so disturb the Sight. *Platerus* more rightly, that the splendid vitreous Humor might fill up a necessary space between the Chrystalline and the Retina, which others explain more clearly, that the glassie Humor may give a passage to the Species to the Retina, and may refract them from Perpendiculars.

The Chrystalline (which some call the icie because of its firmness) is so called from its exceeding bright and shining colour, which it hath, being free from all other colours, that it may receive all colours, it is shining, indifferently hard, round behind, with some longness, flat on the fore side: howbeit according to the sundry affections of the Eye, this form is variously changed.

The Chrystalline. Its Use is, to be the chief Medium of sight, as a glass held before the hole, receives the external species into a dark Closter, even so the Chrystalline Humor; both receives and collects the Species or Representations of things. And because the humor is transparent, the Species are not stopped therein, nor colours perceived, which most Anatomists have believed after *Galen*; for otherwise there were no reason why they should not be as well perceived in the Cornea, and vitreous Humor, both transparent and animated. Therefore the sight is not primarily made in this Humor, but the Species are discerned in the retina tunica, because there they are stopped by a dark Body, as we seen on the Wall of a Chamber, when the Windows are shut.

Scheinerus conceives, that the Species which did represent all things the bottom upwards, are corrected and refracted in the Chrystalline Humor, so as to represent all things in their due posture. But according to the Observation of *Job. Walaeus, Fr. Sylvius, and Fr. Vander Schagen*, the Choroides, the Scleritica, and Retina tunica, being taken away from behind, all things are seen by the Eye, and represented with the bottom upwards; very small in an Oxes Eye, somewhat greater in a Mans. *Plempius* proves the same by an Experiment of a glass Instrument filled with the three Humors, placed before the hole of the Window, where all things appear on the Wall with the wrong side upwards. And doubtless the Species must needs be represented with the bottom upwards in the Retina, otherwise we should see all things the wrong end upwards, and not right, which *Keplerus* hereby demonstrates, because in passion the Patients must be just opposite against the Agents.

Others will have it, that our Judgment corrects the depraved Figure, which discerns the just Magnitude of things by very small Species received. *Others* alledg the common Sense, which seeing the inverted species, behind and above the Cavity of the Retina, apprehends them in their true posture. Finally others say that a true Judgment is therefore made, because it is made by a right Line.

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Chap. IX. Concerning the Ears.

THE Organ of Hearing, viz. the EARS are either external or internal.

The external which are by some termed *Auriculae* the Earlets, are in Mankind of a semicircular Figure, convex without, concave within.

The outer Ear is divided into the upper and lower part.

The upper is broader, and by some called *Pinna*, by others *Ala*. The lower is soft and hanging down, termed *Fibra, Auricula infima, Lobus.*

The outer Circumference of the Ear is called *Helix*, also *Capreolus*, because of its wreathed formed. The inner part opposite to the former, is termed *Scapula* or *Anthelix*. In the middle hereof is a large Cavity, the principal part of the external Ear, called *Concha*. But the Cavity near the *Meatus auditorius* or Hearing-passage, where Ear-wax is collected, is cal'd *Alveolum*. Towards the Temples there grows a certain eminency like a covering, which either receives or hides things.

things that would go into the Eare, and is termed *Hircus* the Goat, because Hairs grow thereon.

The Parts whereof the external Ear is composed, are either common, as the Skarf-Skin, the Skin, a Nervous Membrane, Flesh, and a little Fat in the Lobe : Or Proper, as Muscles, Vessels, and a Gristle.

Its Skin. The Skin is exceeding thin, cleaving to a little Flesh with a firm Gristle ; and as in the Palms of the Hands a Nervous Membrane is firmly fasten'd thereto ; by the sense whereof it happens that cold water sprinkled on the Lap or Lobe of the Ear doth cool the whole Body. In the Lobe it is so mingled with Flesh, that it becomes thereby fatish, fleshy and spongy : Hence the Lobe is soft and flexible, so that it may be bored with no great trouble, and therefore some hang Jewels and Ear-rings thereon.

Its Vessels. As to Vessels : it hath Veins from the Jugulars. Arteries from the Carotides.

Little Nerves, two from behind, and two from the sides, arising from the second pair termed *Cervicale*.

The Muscles. Muscles rightly conspicuous in such as move their Ears, are common or proper. which it was my luck once to see, and such *Justinian* must have had, whose Ears could move as *Procopius* describes him. But in most people the Ears are unmoveable, both because of the smallness of the Muscles, and because there was little need of their motion, because a Man can do that with his Hands which Beasts do with their Ears, wherewith they drive away flies.

Why few move their Ears ? The use of the first Muscle is common to the Ear and each Lip ; and it is a part of the first Muscle which moves the Cheeks, and the Skin of the Face, and it is termed *Quadratus*, the square Muscle, sufficiently thin and broad. It is implanted into the Root of the Ear under the Lobe, that it may draw the Ear to one side downwards.

The use of the second Muscle. The second is proper and seated more forehead, leaning upon the temporal Muscle, from the end of the Muscle of the Forehead (from which it differs by the carriage of the Fibres) arising sometimes with a round, otherwhiles with a corner'd beginning, and being Tendinous, it is implanted into the upper part of the Ear, where it is narrower, that it may move the Ear upwards and forwards.

The use of the third Muscle. The third and hinder more arises above the *Processus mammillaris*, from the hind-part of the Head and its Muscle, with a narrow beginning ; afterward growing broader and divided as it were into three parts, it goes hindlongs to the Ear, that it may draw it, somewhat backwards and upwards.

The use of the fourth. The fourth arising from the *Processus mammillaris*, being broad, grows narrower by little and little, till at last it ends in a Tendon. This Muscle is rather threefold, because it hath three Insertions, yet all spring confused from one place. Some of these are sometimes wanting, otherwhiles they are all found ; sometimes there are more, nature variously sporting her self in the Muscles of the Ear.

The Ear Gristle. The Ears Gristle, is a substance tied to the *Os petrosum*, by a strong Ligament springing from the Pericranium.

Certain *Kernels* there are outwardly about the Ears, thick and large, which are termed *Parotides*, though this word do also signifie the swellings of the said Kernels.

They are not only behind the Ears, as is commonly imagined, but on both sides and under the Ear, but not above.

These *Kernels* by the Ears are called the *Emunctories* of the *Brain*, because they receive the Excrements thereof.

There are also many other Kernels in the whole space which is under the lower Jaw, in which many Diseases are bred, and swellings called *Scrophule* in some Creatures, as wild Swine. The common people count these Kernels a dainty dish and call them Sweet-breeds.

Their Use is, to moisten the parts, and to assist in the divisions of the Vessels.

The Use of the External Ear is,

I. For Ornament, and therefore the English, Dutch and other Nations punish Male-factors by cutting of their Ears.

II. To safeguard the Brain, that it may not be hurt by the Air suddenly rushing in.

III. To be the Organ of Hearing, not principal, but assistant. The true Organ lies within, as doth that of the swelling. And as the Nose being cut off a Man can smell though imperfectly ; so if the Ears be quite cut off close to a Mans Head, he can Hear, but dully, confusedly, with a murmuring noise, so that Articulate words will seem as the noise of Water-streams, or the screekings of Grass-hoppers, as they know who have lost their Ears. Yea, and the Hearing of that Ear which is not cut off, is damaged, unless the cut Ear be stopped.

The Use therefore of the External Ear, is more readily and rightly to receive sounds ; and to gather them when they are scattered in the Air into the Cavity of the Ear, that they may come unto the Drum without violence, being first moderated and allayed in the hollow and winding passages. Hence, least sounds which are driven towards the Ears, should slip beside, Beasts turn their Ears this way and that way to sounds. Hence also the Emperor *Hadrianus* ; that he might hear more distinctly, would hold the hollow of his Hand before his Ears, which also deaf persons frequently practise. Hence some Scythians, whose eardrums are mortified and rotted of with cold, doth apply a Fish-shell to their Ears, that the Air being detained in the Cavity thereof, may be more easily received, that so they may hear the better. Hence, they hear most exactly, whose Ears stick furthest out from their Heads, and if our Ears were not too much pressed down, what by long lying upon them. what by the binding of Nurses, we should hear better then we do.

The Internal Ear hath also sundry parts contained in the *Os petrosum*, and besides the parts and little cavernes of the Bones, there are : The Drum, two Muscles, the Vessels and imbed Air.

In the auditory passage cloathed with Skin, through which sounds are carryed, is found a Cholerick clammy humor, which the Ancients call'd *Cerumen*. Ear-wax, being purged from the Brain : but Intrinsically it is obliquely placed before this hole or passage of Hearing.

T

There

There is a certain *Partition*, or little Orbicular Membrane, compassed with a boney circle, which some call *Myrtix*, others *Sextum Membranum* and

Tympanum. *Mediastrinum*, others *Tympanum*, but some rightly *tympani Membranula*. For it is stretched before the internal Cavity containing the congenit Air, as the Parchment or Velum on a Drum Head. *Casseri*us conceives that it arises from the Pericranium, but *Vestlingius* believe that it is an expansion of the Periosteum, who hath also observed it to be double, and also frequently crusted over by thickned Excrements.

It is exceeding dry, that it may sound the better, for dry bodies are fittest for sound.

A cause of Deafness. It is *Transparent* thin and subtile, that the sounds may more easily pass through to the implanted Air: For those that have it thick from their birth, have an incurable Deafness, as those also who have a thick Coar growing over the same without, the Cure whereof is nevertheless taught by *Paulus*; and if this happen from the birth, such persons continue for the most part Dumb, because they can neither conceive in their mind nor utter with their Tongue such words as they have never hard. But if a Snotty matter cleave thereto within, or a thick Humor flow thereto, a thicknes of Hearing or a Deafness incurable is thereby caused. If a thin Humor flow thereto, there arise tinklings and noises in the Ears.

A Cause of thicknes of Hearing. Finally it is Nervous, of so exquisite a Sense that, it can neither bear the putting in of a Probe, nor sharp Humors; yet is it strong so as to endure against external Injuries; for being hurt or corroded it causes thicknes of Hearing or Deafness, as they find by experience, who have it hurt by the noise of great Guns or Bells, or in whom it is broken by swimming. For the safeguard therefore hereof, there are three little Bones added within (of which, the Hammer sticks fast to the Drum, and is seen through the same) and two Muscles.

The Use thereof is, to shut the passage of hearing, and to separate the innate Air from that which is external, and to keep it within. Also to save it from Dust, Water, creeping things, &c.

Within the Membrane of the Tympanum, there is an *Internal Cavity* in the Bone, containing a certain Air, which some term the inbred, *Congenit* and implanted Air, because it is placed in the Ears at the first formation, being pure, subtile and immoveable: which some count the internal Medium of Hearing, others the Organ it self of that Sense.

There are two Muscles of the inner Ear according to Anatomists.

Muscles of the inner Ear. They call the first the *Internal*, seated in the *Os petreum*, with a double Tendon: The one being fixed to the higher process of the Hammer, the other to its Neck.

Its Use is to draw the Head of the Hammer obliquely inwards, and to carry it inwards from the Anvil, and the process of the Hammer being bowed back, to drive the little Membrane inwards.

The second is external, found out by *Casseri*us, though *Aquapendent* doth likewise attribute to himself the Invention thereof; it is exceeding smal, fleshy, and consisting in the upper Region of the Auditory passage, with its Tendon implanted into the Centre of the Membrane, there where the Hammer is in-

wardly joyned to the said Membrane. So that *Parissanus* labours in Vain by denying this Membrane in contradiction to *Casseri*us.

Its Use is to draw the Membrane with the Hammer outwards.

A certain smal Griftly passage is to be observed, which goes from the *Concha* of the Ear near the sides of the *Pterygoidean* process, to the Palate. *Fallop*ius saies it is a conveyance of Water, furnished with a *small Valve*, *Riolanus* in the mean while, an old Master of Anatomy, denying that there is any such Valve to be found.

The Use hereof is, 1. To purge the inbred Air, for this way Excrements pass from the Ear into the mouth, but, not back again, because there is a Valve to hinder. And this is the Reason that Masticatories are very helpful in Diseases of the Ears.

II. To let in sound in Deaf and stopped Ears.

Varro writes and *Pliny* with *Archelaus*, that Goats draw in Breath at their Ears, which *Aristotle* reports of *Alcmeon*. And such as are somewhat thick of hearing, do perceive words more distinctly when they Gape, and when our Ears are stopped, we can hear our own Speech though weakly. Such as have the Venereal Disease, are hurt not only with cold Air, but with any other uneven noise, passing through their Mouth into their Ears, as *Tulpius* observes, who also hath observed that two persons troubled with the *Orthopnea*, were saved from choking, by voiding their Breath out at their Ears, by means of this passage. Those do abuse this passage, who render the smoak of Tobacco which they take, through their Ears.

Finally, we meet with the Nervous Auditories or Hearing Nerve, which proceeds from the fifth pair of the Brain, entering the Ear through the hole of *Os Petrosum*. It touches the *Cochlea* and the *Labyrinth* with a double branch that it may in both places perfect the Hearing. To which a Branch is added to move the Muscles, proceeding from the fourth pair, and cleft in two.

Chap. X. Of the Nose.

ANother Organ of Sense follows, viz. The Nose the Instrument of smelling, given to Men and fourfooted Beast that bring fourth living Creatures.

Now it is divided, as the Ear, into the External and Internal Nose.

The Internal hath Bones and Nerves, with the Mammillary processes, of which in their place.

The External is Extrinsically divided into the upper and lower part.

The upper part which is boney and immoveable, is termed the Back of the Nose, and its Acuminated part, *Spina*. The lower part is Griftley and moveable, the utmost end whereof is termed *Globulus* and *Orbiculus*, by the only feeling whereof *Michael Scotus* pretends to tel whether a Maiden have lost her Virginity. The lateral or side parts are termed *Pterugia ala*, *Pinnæ*; that is Wings or Pinnacles, that fleshy part which sticks out in the middle near the Lips, is called *Columna* the Pillar.

The Nose is divided within, by a partition Wall, into two Holes or Cavities which they call *Nares* the Nostrials:

Why Masticatories help in Diseases of the Ears?

The Names of the parts of the Nose.

Nostrils : that one hole being stopped, we may draw in and pass out the Air by the other. And when both are stopped, the Mouth supplies the Office of the Nostrils. Now each hole is again *divided* about the middle of the Nose into *two parts* : the one ascends upwards, to the *Os Spongiosum* ; the other goes above the Palate into the Throat and upper part of the Mouth. Hence drink sometimes comes out at the Nostrils : and things put into the Nostrils, the Nose being shut, are wont to slip into the Mouth. Hence also the thicker Excrements also of the Brain, while they are carried downward to the Nostrils, may slide into the Mouth, or be brought thither by Hawking, and so purged out at the Mouth.

It is situate in an high place, *viz.* between the Eyes. 1. For comeliness Sake. 2. Because all smells mount upwards.

The Magnitude varies, as also the Figure, for some have great Noses, others little Noses, some Hawkenoses and Roman-noses, and others saddle-noses &c. Touching which *Physiognomists* Discourse.

Its Substance consists of the Scarf-Skin, Skin, Muscles, Bones, Gristles, Vessels, and Tunicles.

Its Skin is thin, and void of fat, that it may not grow too much ; under the partition in the Colomme it is thick and Spungy ; so that it is like a Gristle and is compact with Hairs termed *Vibrissæ*.

There are eight Muscles of the Nose, especially in large Nosed people, but they are small because the motion of the Nose is little. *Four serve to widen the Nose*, while the *Alle* or Wings being drawn upwards, they open the holes of the Nostrils. And there are *four more which straiten the Nose*.

The *two first wideners* being fleshy, do arise from the Cheek-bone, near the Muscle of the Lips, which they make a third. They are inserted partly into a part of the upper Lip, partly into the lower Wing. *Casseri* found them resembling the leaves of Myrtle.

The parts of the Nose.

The Skin.

Muscles of the Nose.

The FIGURE Explained.

This TABLE represents the Muscles of the Forehead, Eye-lids, Nose, Cheeks, Lips, lower Jaw and Ear-let.

- a. The Pericranium.
- b. The Periosteum.
- c. The Hairy Skin or Scalpe.
- d. The Skull made bare.
- e. The temporal Muscle.
- f. The upper Muscle of the Ear.
- g. The Muscle of the Hind-part of the Head, stretched out to the hinder Muscles of the Ears.
- h. The Muscle of the Fore-head.
- i. A frontal Appendix spread out upon the Back of the Nose.
- kkk. The orbicular Muscle of the Eye.
- l. The triangular Muscle of the Nostrils.
- m. The common muscle of the Lips, which lifts up.
- n. The first proper muscle of the upper Lip.
- o. The second proper Muscle of the upper Lip.
- p. The trumpeters Muscle.
- q. The chewing Muscle.
- r. The common Muscle depressing the Lips.
- s. The proper Muscle of the lower Lip, called Mentalis depressor.
- tt. The third common Orbicular Muscle of the Lips.
- u. The Circular Muscle of the Nose.

The IX. TABLE.



xxx The part of the Earlet termed Helix.

y. The opposite Part call'd Anthelix.

z. The part of the Ear-let call'd Tragus.

a. The Antitragus.

v. The Lobe or lap of the Earlet.

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The other two which are commonly triangular, and like the Greek letter Δ on each side one, with a sharp and fleshy beginning, do grow from the Suture of the Forehead by the *Foramen lachrymale* or Tear-hole, and are implanted into the *Spina* or the *Pinna* of the Nose. I have sometimes observed an Appendix thereof to

have descended to the upper Lip, *viz.* in such as cannot lift up their Nose without their Lips. *Casseri* against the mind of all Anatomists, draws its original from the *Pinna* of the Nose ; but they are moveable.

The two first *Straiteners*, which are little do arise fleshy,

fleshy, about the Root of the Pinnæ, are carried along transversely, and inserted into the corners of the Alæ. *Casseri* did first of all observe a portion thereof and describe it, which is not always found; for more often the circular sphincter involves the Pinnæ of the Nose orbicularly. The Use thereof is a little to shut the Nostrils, depressing the Pinnæ.

The remaining two are exceeding firm and membranous, lying hid under the Coat of the Nostrils, in the inner part. They arise from the Extremity of the Nose-bone, and are implanted into the Pinnæ or Wings.

Besides these Muscles of the Nose aforesaid, I have found on the Nose-back of a certain person, a fleshy Muscle, thin, stretched right out from the frontal muscle, with a broad Basis, and ending soon after, narrower about the outmost Gristle of the Nose.

The Gristles of the Nose. Gristles do make up the Substance of the lower part of the Nose, and are five in number.

The two uppermost being broad ones, do stick unto the Bones of the Nose, and the more they descend, the softer they grow, so that the end of the Nose hath a substance, partly gristly and partly ligamental.

The third being in the middle of the other two, makes the partition-wall between the two Nostrils.

By these are placed the other two, of which the Pinnæ of the Nose are constituted, and they are tied together by membranous Ligaments.

Its Vessels. As to Vessels. It hath Veins from the Jugulars.

Arteries from the Carotides.

Nerves from the third pair, on each side one, which goes through the holes common to the Nose and eyes, at the greater corner into the Coat of the Nose, and the Muscles, and the Palate.

The Coat of the Nostrils. The Coat which cloaths the Nostrils is from the dura Mater, and common to the Mouth, Palate, Tongue, Larynx, Gullet and Stomach; but in the Nostrils it is thinner and of exquisite sense;

The cause of Sneezing. for being vexed it causes Sneezing: it is bred with many little holes which go into the Os cribrosum.

Riolanus informs us that within the Cavities of the Nostrils, there are spongy parcels of flesh to be seen, of a reddish colour, wherewith the spongy bones of the Nose are filled, of which being swelled, the Disease in the Nostrils, called *Polypus*, is bred, touching the pulling out and cure whereof, read *Tulpius*.

The use of the Nose. The Use of the outer Nose is 1. That through it air may enter into the Brain for the needs of the Animal Spirits.

2. That by it air may enter into the Lungs, for the cooling of the Heart, and to breed vital Spirits.

3. That by the Nostrils Odours may be carried to the Mammillary processess, which lie concealed above the Os cribrosum. And therefore they whose Nose is cut off at the Roots, cannot smell at all, or badly.

4. That the Excrements of the Brain may flow down there through, as by a Channel. Which is but a secondary use of the Nose, because *Jo. Walaeus*, *Jo. Dom. Sala* my Masters and my self, have known some persons that never voided any Excrements at their Nose.

5. It is also sometimes assistant to the Voice.

6. It adds an Ornament to the Face. It is storied in the Chronicles of England, how a company of ho-

nest Maidens of that Country, in the time of the Daneish War, did cut off their own Noses, that they might preserve their Maidenheads from the violence of the Daneish Soldiers, by this deformity. This was the punishment of Adulterers in Egypt, which also *Jehovah* threatens to the Inhabitants of *Hierusalem*, by the Prophet *Ezekiel*. In our Historiographer *Saxo*, we read how *Hialto* deformed a Curtezan by cutting off her Nose, when she asked him who should be her next Lover. And therefore because it inakes much for the Ornament of the Face, the *Chirurgia Curatorum* was invented, teaching how to supply a Nose in the room of that which is cut off, of which see *Tagliacotus*.

Chap. XI. Of the Mouth, Cheeks and Lips.

THE last Organ of Sense remains, viz. the Tongue the Organ of Tasting, which before I explain, I must propound the external parts about the Mouth, and the internal parts in the Mouth.

The external parts about the mouth are sundry. The upper part under the Eyes, between the Nose and the Ears, by reason of its usual Redness, and the unusual by reason of blushing, is called *Pudoris sedes* the Seat of shamefastness, *Malum* or *Pomum* the Apple, also *Circulus Faciei*, the Circle of the Face.

The lower and looser part which may be blown up, as we see in Trumpeters, is termed *Bucca* the Cheek, the upper part of the Lip is called *Myrtax*. The Cavity imprinted therein and dividing the same, is called *Philtrum*, from its loveliness. Now the Lips are two, the upper and the lower, and the chink between both, is termed *Os* the Mouth. The outer parts of the Lips which hang over, are called *Prolabia*. The lower part under the lower Lip is called *Mentum* the Chin; the fleshy part under the Chin is termed *Buccula*.

Now the Mouth consists of parts, partly boney, as the upper and lower Jaw with the teeth; partly fleshy, as the Lips, Lip-muscles, Cheek-muscles, and lower Jaw-muscles.

The whole inner capacity of the Mouth is cloathed with a thick Coat, which goes also about the Gums and Lips, and is thought to be doubled when it constitutes the Uvula.

The Uses of the Mouth are:

1. To receive in Meat and Drink, and to prepare the same, or begin Chylification the beginning, of which is performed in the Mouth.

2. To receive in and let out the Air.

3. To speak and frame the Voice.

4. To give passage to the Excrements of the lungs, the Head and Stomach, by hawking, spitting, and vomiting.

Two pare of Muscles there are, common to the Cheeks and Lips, on each side two Muscles.

The first is that same broad and square muscle lying under the skin of the neck, which the Ancients did not distinguish from the Skin.

It arises about the Channel-bones, and the hinder part of the Neck; and with oblique Fibres (which a Surgeon must diligently observe, least he cut them freely and athwart, and so make the Cheeks to be pulled

The Names of the outward parts about the Mouth.

The use of the Mouth.

Two pare of Muscles common to the Cheeks and Lips.

ed away to one side) it is implanted into the Chin, the Lips and Root of the Nose, and sometimes of the

Spasmus Cynicus. Ears: which parts also it moves to the part, and this is first cramped in the *Spasmus Cynicus*.

The second lies under this, which makes the Cheeks with its Bulk, and therefore is termed *Buccinator* the trumpeting Muscle, which is most conspicuous in Trumpeters.

The Figure of the Muscle Buccinator. 'Tis round like a Circle, thin and membranous; interwoven with sundry Fibres, inseparably clothed with the coat of the Mouth.

In the Centre hereof *Cassorius* hath observed a certain strong band, breeding from without, and creeping to the Cheek-bone, where it is terminated into a certain small and lean Muscle, directly opposite to the Bucca.

This Muscle arises from the upper Cheek-bone; is inserted into the lower, at the Root of the Gums.

Its Use is to move the Cheeks and Lips; and it is to the teeth instead of an hand, while it thrusts the meat this way and that way to the teeth, that it may be more exactly chewed.

The Lips. The Lips consist of undigested spongy flesh (*Fallopins* reckons it for the ninth pair of Muscles which move the Lips) whose Skin is so mingled with Muscles, that it seems to be a muscular Skin, or a skinny Muscle.

Trembling of the Lip in such as are ready to cast, how caused? They are covered with a Coat common to the Mouth and Stomach: and thence it is that in such as are ready to vomit, the lower Lip trembles.

The parts of the Lips which touch one another are red, because of the afflux of blood.

Their Use is, 1. To shut in the Mouth and Teeth, and to defend the inner parts from cold and external Injuries.

2. For the conveniency of Eating and Drinking.

3. For the Voice and Speech.

4. To cast out the Spittle, and therefore that Servants might not spit nor speak, they were bound with Skins, as *Ammianus Marcellinus* informs us.

5. For Ornament.

There are some proper Muscles of the Lips besides the common ones aforesaid, which nevertheless may vary in respect of number. Some reckon fewer, and others more: for some are by some Authors counted simple, which others reckon to be manifold.

The proper Muscles which move the upper Lip are on each side two. Three there are which move both Lips. The lower Lip is moved only by one proper pare.

Four pare of muscles moving the upper Lip. The first pare proper to the upper lip, is a remarkable pare described by *Fallopins*, which slipping down from the corner betwixt the Eyes and Nose, is straight way sunk into the Substance of the upper Lip.

The other pare, arising from the upper Jaw-bone, just in the Cavity of the Cheeks under the Socket of the Eye, thin but broad, fleshy, sunk into store of Fat, is carried downwards right on, to the upper Lip, which moves it directly upwards with the first pare. Sometimes also it is obliquely inserted into the confines of both the Lips, wherefore some do make two pare thereof.

Muscles common to both Lips. The first pare common to both Lips, is long, fleshy, broad at the

beginning; arises outwardly from the Jugal process, and descending obliquely through the Cheeks, it is terminated in the space between the two Lips. Sometimes I have seen it from the beginning drawn out as a Rope to the first proper pare. Its Use is, to draw both the Lips obliquely upwards towards the Temples.

The second common pare of the Lips, from the lower Jaw-bone to the sides of the chin, fleshy, arises with a broad beginning, and sometimes stretched out to the middle of the chin, grows by little and little narrower, till it is obliquely inserted into the same confine of each Lip, but lower, which draws away the Lips obliquely downwards and outwards, in such as grin and gurn for anger.

The third Muscle common to the two Lips is circular like a Sphincter encompassing and constituting the whole Mouth, spongy, and firmly sticking to the ruddy Skin, it draws the Mouth together; when people simper as Virgins are wont to do.

The proper pare of the lower Lip is called *Muscles of the lower Lip.* *Par Mentale*, the Chin-pare; arising from the middle of the Chin with a broad beginning, and ascends directly to the middle of the lower Lip, which it moves downwards.

Now all the Muscles of the Lips, are so mixed with the Skin, that the Fibres do cross one another mutually, and therefore the motions of the Lips are very divers.

To cause that exquisite Sense which is in the Lips, Branches of Nerves are sent thither, and Veins and Arteries from the neighbouring places: from whence that same ruddy splendor of the Lips proceeds, a note of Beauty and of Health.

The Muscles of the lower Jaw (for it is moved) the upper being immovable) some reckon eight, others ten, called *Massiculatorij*, *Mandibularij*, *Molares*, *Chewers*, *Bas-*

ters, *Grinders*, because they serve for the chewing or grinding of the meat. One only pare depresses the Jaw, because it is apt to go downwards of it self: the other pares fetch it up; which are exceeding strong ones. Hence it is that some can take heavy weights from the ground with their teeth, and so carry them. Hence phrantic and otherwise distracted persons do shut their mouths with so much stubbornness and strength, that they can hardly be opened with great force and iron Instruments. Contrariwise, the stubbornest person in the World may be compelled without much ado, to shut his or her mouth.

The first Muscle is termed *Crotaphites*, *Temporalis*, the temporal Muscle from its Situation, because it possesses the Cavity of the Temples.

This is the greatest of them all, firm and strong, yet firmer and stronger in some Beasts, as Lions, Wolves, Dogs, Swine, &c. which were naturally to bite hard.

For the Head of the temporal Muscle, is in the beginning of the lower Jaw, which it moves and draws upwards, and so shuts the mouth; and it is terminated in a sharp process, with a tendinous Nerve short and strong.

Now it arises from the Temples with a beginning broad, fleshy, and semicircular, and by little and little grows narrower as it descends.

Three Nerves are on each side inserted thereinto, two from the third pare, another from the fifth pare. And therefore this Muscle being wounded or bruised, there is great danger of Convulsion and

The use of the temporal muscle.

Why is dangerous to bite the temporal muscle.

of Death in conclusion; especially if the lower part be hurt which is most Nervous. And because of the distention hereof, *Hypocrates* did pronounce the Luxation of the lower Jaw-bone to be deadly, unless it were put presently in joyn again.

For safeguard sake, Nature hath given it, 1. A Membrane thick and hard, and black and blew in color, wherewith it is covered, and shines with a near color; the Pericranium, so that the inner part of the Muscle being all fleshy, doth there stick to the bone without the Pericranium. 2. The *Osi jugale* over the lower part Tendinous and Nervous. 3. She hath fenced the Tendon with flesh above and beneath.

The second Muscle is the *Manforius primus*, first chamer, called *Masseter*, *Molitor*, and *Mandibularis*, or *Lateralis*, seated in the Cheeks.

It arises from a double Head: the one fleshy, the other Nervous, from the *Osi jugale*, and the first bone of the upper Jaw. It is implanted into the lower part of the Jaw-bone (by a Connexion sufficiently broad and strong) which it turns this way and that way, in such as are eating. For the Fibres of the Head do so interfere and cross one another, that they move the Jaw both forwards and backwards and sideways.

The third pair is the *Pterygoidei* or *Alari externum*, the outward Wing-muscle, the finding whereof we owe to *Fallopis*; but *Vesalius* accounts it a part of the temporal Muscle. 'Tis seated under the temporal.

It arises from the *Osi Sphenoidium* and the external process *Alaris*, with a beginning partly Nervous and partly fleshy. 'Tis implanted into the Neck of the lower Jaw-bone, and the inner seat of the Head thereof.

Its Use is to move forwards and thrust out.

The fourth is termed *Manforius alter*, the other Chewer, or *Alaris internum*, being thick and short.

It arises Nervous from the Productions of *Osi Sphenoidium* called *Alata interna*; and is inserted into the inner and hinder part of the Jaw, with a broad and strong Tendon.

Its Use is to draw the Jaw upward and backward, to assist the temporal Muscle.

The fifth is termed *Graphyoides*, because

It arises from the Appendix *Stryloides*, Membranous and broad, and soon becoming round and fleshy, 'tis inserted into the Chin. Hence it is seen to have a double belly, and therefore 'tis also termed *Digastricus*, twi-belly. 'Tis fastned to a Ligament least it should go too far back. For,

Its Use is to draw the Jaw downwards and so to open the Mouth.

Others do reckon for another pair, part of the *Musculus quadratus*, fixed in the middle of the Chin. Which broadest Muscle, arising from the upper part of the Breast-bone, the Channel bone and the Shoulder tip, and covering the Neck and the whole Face, after *Galen*, *Sylvius*, and *Theophilus*, *Riolanus* describes in this place. I spoke thereof, in the beginning of the Chapter.

Chap. 12. Of the Parts contained in the Mouth, viz. the Gums, Palate, Uvula, Fauces, and Throat-bone.

Parts contained in the Mouth besides the Teeth: are the Gums, Palate, Uvula, Fauces, Tongue-bone, Tongue, Almonds or Tonfille, Larynx, and beginning of the Gullet. Of the three later I spoke in my second Book, because of the Connexion of Parts. Of the five former, we will treat in this Chapter and of the Tongue in the Chapter following.

GINGIVA the Gum, is an hard flesh coming passing the Teeth like a Rampart, and in *Gingiva*, such as have lost their Teeth, serving in some measure to chew their meat: which being either eaten away, or too much relaxed, or overdryed, the Teeth become loose, or fall out.

PALATUM the Palate, is the upper part of the Mouth moderately hollow, like the Roof of an House, whence it is called the Heaven of the Mouth, and is the Basis or Foundation on which the Brain rests, being made of the *Osi Sphenoidium*.

'Tis invested with a thick Coat arising from the dura Mater, which covers the Cheeks and whole mouth on their Insides, and is common to the Gullet and Stomach, and therefore there is also a consent between these parts. Nor can we purge the Head with Masticatories, unless we purge also the Stomach by the Palate.

'Tis furnished with small Nerves for Sense.

The UVULA hangs from the Palate further into the Mouth near the passages of the Nostrials, over the Chink of the Larynx among the Almonds or Kernels so called. Some call it *Gargaren*, from the noise it makes when we Gargle any Liquor; 'tis also called *Gurgulio* and *columna*.

It is a Process made of a Glandulous, Spungy and red substance, which *Columbus* doth suppose to be made of the Coat of the Palate Reduplicated in that place. *Riolanus* rather believes that it is flesh, arising from the extremity of the Muscles, which are carried to the Body.

It is round & long, thicker above, and ends in an acute Figure abruptly. It is suspended and held up by two little Muscles, an Internal and an External pair, either to stir the Uvula Forward and Backward in the time of swallowing, or when it is relaxed with Humors and falls down, to draw it up again.

Riolanus, from *Aretaeus*, the Author of *Anatomia Vidorum*, *Abensina* and *Carpus*, describes two broad Ligaments fastening the Uvula on both sides, like to wings spread abroad, which the Arabians term *Galsamach* of which he is worthy to be consulted.

Sometimes by reason of Humors too much flowing in, it hangs too much down, which is called *Casus Uvulae* the falling down of the Palate of the Mouth. Which if it cannot be restored to its place by Medicaments nor manual operation, it is wont to be burnt and cut by Skillful Chirurgeons.

The FIGURES Explained.

In this TABLE are shewn
Os Hyoides, Uvula, and
certain Muscles of the
Tongue.

FIG. I.

- A. The Gargareon or Uvula, in Eng-
lish the Palate of the Mouth.
BB. An outward pair of Muscles.
CC. Its tendon.
DD. An inner pair of Muscles, a little
compressed.
E. Part of the Roof of the Mouth,
at which the Uvula hangs.

FIG. II. & III.

- AA. The Basis of Os Hyoides.
BBBB. The sides or horns of the said
Bone.
CC. Two Gristly Appendices.

FIG. IV.

- A. The first Muscle of the tongue, aris-
ing from the external Face of the
Styloides.
B. The second Muscle of the tongue.
C. A Muscle of the third pair called
Genio-glossum.
DD. The fifth pair Cerato-glossum,
situate without.
EE. The tasting Nerves.
FF. The tongue moving Nerves.
G. A muscle of Os Hyoides.
H. The Processus Styliformis.
II. The Os Hyoidis.
K. The Cartilago Scutiformis.
LL. Two muscles proper to the Larynx.



Its Use is to moderate, the coldness of the Air, that
it may not suddenly rush into the Lungs: and there-
fore those that have lost the Palate of their Mouths dye
of a Consumption.

Some think it helps to modulate the Voice,
Vulgar and therefore they call it *Pletrum vocis*, the
Error striking quill of the Voice. But though it be
wounded or quite cut off, yet is not the
voice hurt, unless some neighbouring parts, which
assist the voice are also damaged: for then by the
roughness of those parts, caused by those Catarrhes,
which have eaten the Uvula, the Voice becomes
Hoarse.

A second Use is, to hinder drink from passing out
of the Mouth into the Nostrils. And therefore Sal-
muth tells of the Son of a Man called John, who being
born without any Uvula or Almonds, voided the
Milk which he sucked, out of his Nose, and did not
live long.

By FAUCES sometimes we understand the whole
wideness of the Mouth: but more strictly it is meant
of the hinder and lower part, which cannot be seen,

but when the Mouth is wide open and the Tongue
held down, the Greeks term it *Pharynx*, howbeit that
word in *Hippocrates* doth oftentimes signifie the Dis-
eases of this part, as Inflammation, &c. *Galen* calls it
Isthmus because of the narrowness of the place.

In the Fauces is that Bone which
from the shape of the Greek letter *υ* is
called *Hyoides*, *Hyppiloideis*, also from
resemblance to the letter *λ* *Lambdaoides*,
that is the Upsilon or Lambda-shaped Bone. 'Tis
also called *Os gurguris*, the Throat-bone, and *Os linguae*,
the Tongue-bone, of which I must treat in this place,
and not in the History of the Bones, because it is not
fastned to the other parts of the Skeleton.

Now the Bone is the Basis and Foundation of the
Tongue, upon which it is placed and moved: and it
is set before the Larynx.

It consists of sundry little bones,
three at least, sometimes of five, seven,
nine.

The middle Bone is the greatest, bun-
ching without, hollow within, under which sticks the
Epiglottis;

Names of the
Os hyoides.

Its Construc-
tion.

Epiglottis; it hath processes termed *Cornua*, horns two in Number, consisting of Bones more or fewer, greater or lesser.

Four *Gristles* are added, two are somewhat great, long and round, in the Belly of *Oshyoides*, two also besides the Horns, which in some persons become bony.

Its processes are fastened to the Ligaments and ends of the *Styloides*, also with the *Cartilago guttalis*.

This Bone is moved, but not except the *Muscles*. Tongue be moved; and therefore it hath four pair of *Muscles* common to the Tongue, nor can the *Muscles* of the Tongue be shewed till they are removed.

The first pair lies concealed in the fore-part, under the Skin, resting upon the *Weland* and the *Cartilago Scutalis*.

It arises with a broad and fleshy beginning, from the higher and inner Region of the Breast-bone; and therefore this pair is called *Sterna-hyoides*. Its End is fleshy, in the Basis of *Oshyoides*. And in the middle according to their length, these *Muscles* are divided with a line.

Their Use is to draw right down.

The second being under the Chin and the first pair of the lower Jaw; is large, short and all fleshy.

It arises from the inner part of the lower Jaw, with a various carriage of *Fibres*: it is ended in the middle seat of the *Hyoides*. Some call it *Genio-hyoides*.

Its Use is to draw right upwards and a little forwards.

The third is lean and round, seated under the Chin, arising from the Root of the Appendix of *Styloides*; it ends into the horns of the *Hyoides*. Sometimes they are bored through the middle, for the *Muscle* which opens the Jaw.

The Use is, to move sideways, and a little obliquely upwards. 'Tis called *Stylo-cervato-hyoides*.

The fourth being lean and long, lies concealed under that *Muscle* of the Scapula which they count the fourth, moving downwards and obliquely sideways.

It arises from the upper side of the Scapula, near the processus *Coracoides*, and therefore 'tis called *Coraco-hyoides*: it is carried upwards obliquely to the sides of the *Oshyoides*, under that *Muscle* of the Head which is counted the seventh. And this pair is long, hath two Bellies, and is extenuated in the middle like a Tendon, like that which draws down the lower Jaw.

Some add to these a fifth pair, which is indeed proper to the Tongue, *Reclatus* indeed the *Mylo-glossum* and therefore he terms it *Mylo-hyoides*; but *Vestlingus* the *Genio-glossum*, and therefore he calls it the *Genio-hyoides internum*: which arising inwardly from the Chin under the *Par-Genio-hyoides*, is inserted into the Basis of the *Hyoides*, which it draws straight upwards.

The Use of this *Oshyoides*, is I. To be the Basis of the tongue, and yet but obscurely moveable: least as *Walcus* conceives, it should perpetually hang in the Throat, and hinder the swallowing of Meat; but it moves forward in swallowing, and so makes the Office of the Gullet more wide.

II. That from many *Muscles* might arise of the tongue and Larynx.

Chap. 13. Of the Tongue.

THE TONGUE called *Lingua a lingendo* The tongue; from licking.

Is placed in Mankind, in the Mouth; Its Situation, under the Palate thereof:

Is in Number one; in Sea-Calfes two, in Number, Serpents divided into three parts, in Lizards and Snakes divided into two parts.

In Man 'tis long, broad and thick, and thicker at the Root, thinner and sharper at the End. Figure.

Its size is moderate answerable to the mouth, which if it be too great, so that it cannot move readily, it makes a man Lispe and Stutter; and if it be oversoft and moist as in young Children, they cannot speak plainly. *Galen*, *Casperarius*, *Zacutus Lusitanus* and *M. Donatus*, have observed the tongue grown to so monstrous a greatness, that it could not be contained within the mouth.

As to the Connexion, in fishes the whole tongue cleaves to their mouth; Its Connexion, in mankind, it is in its hinder part fastened to the Larynx, and the *Oshyoides*, also to the Fauces and Tonsillæ. Beneath in the middle of its body 'tis fastened with a strong membranous Ligament for strength and stabilities sake, also for the insertion of its proper muscles, whose extremity is termed *Frenulum*; nor can any other string be found different from this. This in many new born Children, doth so tie the whole tongue, that it is wont to be torn by the Nail of the Midwife (which is nevertheless a Pernicious course and not to be allowed) or the small Knife of a Chirurgion, that it may not hinder the Childs sucking or future speaking, and that it may freely turn and move it self. Howbeit for want of skill, they cut it in all Infants indifferently, whereas not one of a thousand, when it is let alone, doth stammer.

'Tis clothed with a Coat (hard in such as use to swallow very hot Liquors) ordinarily thin, soft, and porous, that tastes may easily peirce into the tongues fleshy

Substance, which is a peculiar kind of Substance, flesh, such as is not in the Body besides (and it is the Organ of taste, not the Coat, as *Galen* would have it, nor the Nervus Gustatorius, as some from *Columbus*) soft, loose, rare and spongy, to drink in the tastes brought to it with some humidity. In Fishes and some other Animals 'tis bony. It is rather of a kernelly then a Muscous substance, especially about the Basis thereof.

For the tongue is no Muscle, seeing it hath no Fibres; nor moves any other part, but is moved by its Muscles. Others add this Reason, because then motion would be made towards the end of a Muscle, and the tail of a Muscle should be moveable, the head immoveable. But this Reason is false. For the beginning of the tongue is near the Larynx, and arises as it were from the *Oshyoides*.

As to Vessels. Two remarkable Veins are to be seen under the tongue, which are wont to be opened in Quinsies and Diseases of the Fauces, termed *Ramina* from their color, arising from the external Jugulars, these

Two pretty big Arteries do accompany, from the Carotides.

Nerves are inserted into the Tongue, both those of motion, and those of Sense: a thicker pair creeping through the inner parts, from the seventh conjugation, which being obstructed or not reaching to the Tongue, the last is lost according to the observation of Columbus. A thinner pair runs through the outer parts of the Tongues Coat, arising from the fourth conjugation, or as some say, from the third.

The Tongue is distinguished in the middle of its surface, into the right and left part, by a certain white line, which Hippocrates terms *Mediana*.

The muscles proper to the Tongue, ending in its substance, are by some Anatomists reckoned to be six, by others nine, by some ten, by others eleven, which move the Tongue, upwards and downwards; forwards and backwards; to the right hand and to the left.

The first pair, which in Oxen is double fleshy and thick, arises from the out side of the Appendix Styloides, being Maigre in Mankind: it ends with transverse Fibres, into both sides of the Tongue, about the middle thereof.

Its Use is to move the Tongue inwards. But by reason of the Fibres interwoven, they lift the Tongue upwards if they act both together; but upwards only to one side, if only one of them act. This pair is called *Styloglossum*.

The second pair is called *Myloglossum*, arising from the sides of the lower jaw, at the Roots of the grinding Teeth. Tis inserted under the Basis of the tongue, into the tongues Ligament. Riolanus will have it belong to the *Os hyoides*, because it touches not the tongue. But it suffices to move the tongue, if it be affixed to the Ligament thereof.

Its Use; when one acts, the tongue is moved obliquely upwards; when both act, it moves with its point right to the Palate and upper teeth.

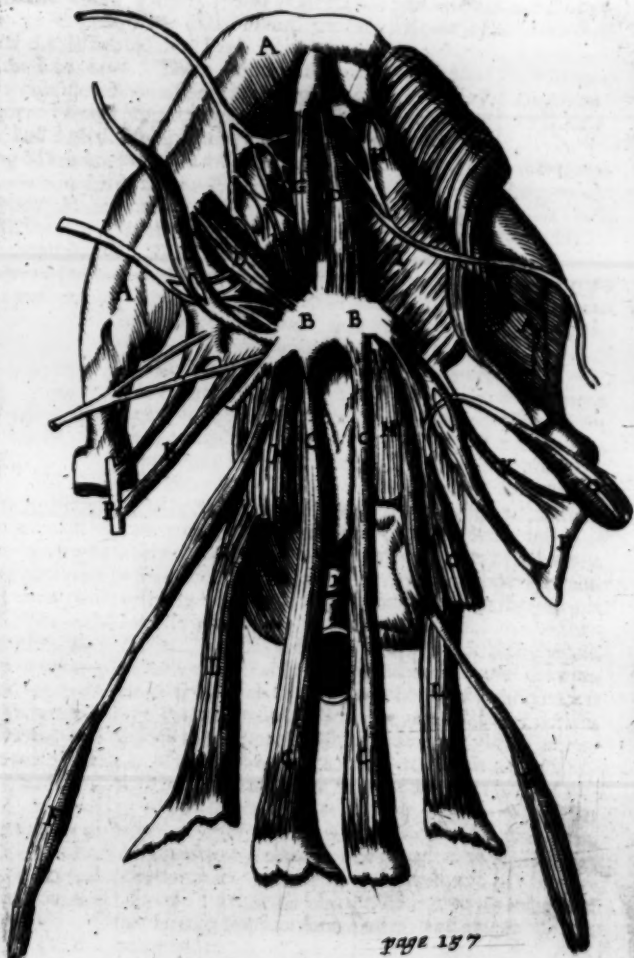
The FIGURE Explained.

This TABLE expresses the Muscles of *Os Hyoides* and of the Tongue.

- AAA. The Body of the lower Jaw.
- BB. The Body of *Os Hyoides*.
- CC. The first pair of Muscles called *Sternohyoides*.
- D. One Muscle of the second pair in its situation, the other removed therefrom.
- EE. The third pair bored in the middle.
- FF. The fourth pair *Coraco-hyoides*.
- G. A Muscle of the fourth pair of the Muscles of the tongue.
- HH. The Parenchyma of the tongue into which the Nerves are inserted.
- I. A Muscle of the first pair of tongue Muscles.
- KK. A Muscle of the first pair of tongue Muscles.
- LL. The common muscles of the Larynx, call'd *Sternothyroidei*.
- MM. Other common muscles of the Larynx, *Hyothyroidei*.
- NN. The Gristles of the *Aspera Arteria*.
- OO. A muscle of the lower Jaw call'd *Digastricus*, Twibelly.
- PP. Portions of the process *Styloides*.

The third pair arises inwardly at the middle of the Chin, whence tis called *Genio-glossum*; it ends, well-near into the middle of the tongue inwardly. *Vestlingius* will have it fastned into the Basis of the *Os hyoides*, and therefore he reckons it amongst the Muscles thereof. And by reason of the diversity of its Fibres, it seems to perform contrary actions: for the greatest part of the Fibres, which is towards the Root of the

The XI. TABLE.



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tongue, being drawn towards the Original, the tongue is thrust without the Lips; but the smallest part of the Fibres acting, tis drawn inwards. This pair hath inscriptions as if it were many Muscles,

The fourth pair arises fleshy out of the upper and middle Region of the *Oshyoides*, and is terminated in the middle, after it is drawn out according to the length of the tongue. It is sometimes obscurely divided, as if it were many Muscles.

Its Use is, to draw the tongue right in, and so to depress the same. And it is called *Basioglossum*, or *Hypoglossum*.

The fifth pair is called *Cerato-glossum*, because it arises from the upper horns of the *Hyoides*, and is obliquely inserted into the sides of the tongue, near the Root thereof.

Its Use is sometimes from the lower horns, viz. when the higher are wanting, especially in Women. And this pair is double in Oxen.

Its Use is, to move the tongue directly downwards towards the inner parts, when both act; but if only one be contracted, it moves it to the right or left side.

By others an *eleventh* Muscle is added, which yet is no Muscle, because it consists not of fleshy Fibres;

but it is a parcel of flesh, consisting of very many Kernels and far, situate at the Root of the tongue, and appearing when the fore-said Muscles are taken away.

Its Use is, that the tongue may be moistened by this plenty of Kernels.

The Use of the Tongue is:

I. To be the Instrument of Taste.

II. Of Speech.

III. To further the chewing of Meat, by turning it this way and that way.

IV. To lick with.

By all which it appears, that the tongue is not necessary to the very being of life, but to the well being: for the part thereof may be cut off without danger of life or health, *Zacutus, Waleus* and others after *Galen*, have found by experience. *Abenzoar, Joubertus, Forestus*, have observed that Stones have bred under the tongue, hindring Speech, till they were cut out; and I remember that long since such stones were taken out at *Padua*.

The use of the Tongue.



THE

THE FOURTH BOOK OF THE LIMBS.

The Limbs what? **B**Y Limbs we understand those Members which grow as it were out from the Trunk of the Body,

Why the muscles also of the Head, Neck, Back &c. are banded in this Book?

viz. the ARMS above, the LEGS beneath. In which are chiefly considered the Muscles, Veins, Arteries, Nerves and Bones. Of the four last I shall treat, in the four following Manuals: but of the Muscles of the Limbs in this Book, as also of the neighboring Parts, viz. the Head, Neck, Chest, Back, &c. their Muscles; not because they appertain to the Limbs, but because in the Order of Dissection, an Anatomist cannot shew them before the Muscles of the Limbs.

Chap. I. Of the Arm and Hand in General with the Nails.

The use of the Hand.

ARISTOTLE calls the Arm with its Hand, *Organon Organon*, the Instrument of Instruments, wherewith Man otherwise naked and unarmed is gifted, that he may not be inferior to the Brute-beasts and conquered by them; but may overcome them, making for himself Weapons, and other necessary Instruments. Man therefore hath received Reason and Hands, which Beasts have not; and the Hand is his Servant and Instrument.

Manus what?

Now the old Writers *Hippocrates* and *Galen* by HAND did understand that Part of the Body, from the top of the Shoulder to the ends of the Fingers, and this is termed *Junma Manus*.

And it is divided into the Arm and Hand strictly so called, or the *extrema manus*.

And the Arm is divided again, into the Shoulder and Cubit, the Shoulder is the part of the Arm from the Shoulder-tip to the bending of the Elbow.

The Cubit is that part from the bending of the Elbow unto the Wrist.

The *Manus extrema* or Hand properly so called, is divided into the *Brachiale* or Wrist, which is the part between the Elbow and Palm; into the *Postbrachiale* or Metacarpum, *after-wrist*, which is the part between the Wrist and beginning of the Fingers, and into the

Fingers. The *Postbrachial* part internal is called the *Palm* of the Hand, the external part is called the *Back* of the Hand.

There are many Fingers, that the action of the Hand might be the better performed, which is laying hold: also that we might be able to take up the smallest matters, which we do by two fingers, and other things of many-shaped Figures: and because all things could not be comprehended with one hand, two were made that meeting together, the one might help the other.

The right Hand is more active commonly and more ready for motion, not for those causes which others childishly cite, but 1. Because in a mans right side is the *Vena sine pari* so called, which peradventure is double in such as can use both hands alike. 2. Because the bones are more heavy in the Shoulder, Shoulder-blade and whol arm, then on the other side, as some men know for certain; which may proceed from an impression of more plentiful Heat in the Mothers Womb, the right part whereof is hotter then the other. Hence *Aristotle* teaches, that naturally the right hand excels the left; and in another place, he tells us the first endeavor of motion is on the right side; so that when a man is about to walk, first moves his right Leg; a Bird about to fly, moves first its right wing. 3. Because the trunk of the Subclavian Artery is greater on the right side then the left, as they know that have diligently considered the matter in opposition to *Riolanus*, though the difference is not, neither needed to be very great. *Plato* conceives that all men are naturally ambidexters, viz. that they can use both hands alike, and that it is mens unskilfulness and ignorance that makes them right handed only or left handed. But *Aristotle* is of Opinion, that from our first Formation, the right sides of our Bodies, are alwaies in a manner hotter and stronger then the left, unless any man by much custom, and much exercise, do draw much Heat and Spirit to his left Hand that he may become Ambidexter, and able to use it as his right.

Now the Fingers for perfection of Action are made five in number, differing in length and thickness. Tis besides nature, if either the Fingers be quite wanting, which I have seen at *Malta* and at *Florence*; or if in place of true Fingers there appear only certain soft marks

Why many Fingers on the Hand?

Why the right Hand is more active then the left?

The number of the Fingers.

marks as big as Peason, which I lately observed here at *Hafnia*.

The *first* is call'd *Pollux* a *Pollendo* because of its strength, and it alone is oppos'd to the whole four, when any thing is to be taken up, and therefore it is such.

The *second* is call'd *Index* and *Demonstrator*, the shewer, or pointer : because therewith we point at any thing.

The *third* is the longest and middlemost, call'd *Impudens* the *shameless*, because Physicians use it in filthy and stinking places ; not is it wont to be adorned with Rings.

The *fourth* is termed *Medicus*, also *Annularis*, the *Ring-finger*, because it is adorned with a Gold Ring before any of the rest, by reason of a common but false opinion Repugnant to Anatomy, viz. that a Vein should come from the Heart to this Finger above all the rest ; now the Heart is comforted with Gold.

The *fifth* call'd *Auricularis* the *Ear-finger*, because fit-est to pick the Ears, is smallest, and by us call'd the *little Finger*.

Lying bold. The Cause therefore of *laying bold*, which is the action of the Hand, or as others speak less accurately, its chiefest use, is the apt composition of the whole Hand. Yet the chief Organ of this motion is a Muscle : the

How the Hand is compounded?

strength is in the Bones, which are three in every finger, the lower of which as the sustainer is alwaies greater then that which is above it and stronger, and in the Joynts they are furnished on each side with a Gristle, on which an Oyle moisture is poured out for Humectations sake, and to Facilitate the motion.

A *secondary* use of the Arms and Hands as *Kyperus* learnedly Discourses, is the better to help our going by their weight and ballancing ; Yea and to speed our going : and therefore dancers on the Ropes, whose Foot is broader then that which they tread on, do bear themselves up with long Poles, and when they dance a pace, they ballance themselves with their Hands, which they move this way and that way.

Of the Nails. The Nails are placed externally on the tops of the Fingers, as also of the Toes : whose upmost part being white, is called the Root of the Nails, the white half Moon, and the little Skin which grows to the Root.

Their matter is not Alimentary Humors ; as *Emilius*, *Parisianus* and *Plempius* would have it, and others, but thick Excrements, nor which ascend from the Heart, as *Rosa Anglicana* conceives ; or from the Arteries, but from the Bones and Gristles, as the great *Hippocrates* doth affirm.

The *Efficiens* is that heat which the Soul directs to this rather then any other part of the Body. But the Nails are not made by the Soul, as *Parisianus* and *Plempius* contend, because in Cacochymick and Phlegmatick persons they grow more abundantly, in such as have been twenty five years dead, according to the observation of *Pareus*. Nor are we moved when they say that there is a great variety of colours in horns and shells of Fishes, for they no more prove the action of the Soul in such things, then in partly coloured and speckled Marble.

Their End and Use is,

I. To fence the ends of the Fingers and Toes which are exceeding soft, and to safeguard them by

their hardness, so that they may more easily take up any thing. So in the Feet, that they may be able to resist the hardness of the Ground and stand firm. And therefore it was ill said by him of old, that the Gods had erred in their placing the Nails.

II. For ornament : and therefore we cover our Fingers when the Nails are impaired.

III. To rub, scratch and defend, which is a secondary use.

IV. To free the Body from superfluous Humors and steams Fuliginous.

V. To afford Physicians and Physitians tokens of Life and Health, which may be seen in divers authors. And *Achmetes* ch. 74. 75. interprets dreams concerning them, according to the Tradition of the Indians, Persians and Egyptians.

Their form we gather from the Accidents.

Their *Figure* is somewhat convex, that they may apply themselves to the Fingers.

They have a substance indifferently hard that they may resist, but yet flexible, that they may yeild a little and not break.

They are *Transparent* and therefore variously coloured : for according to the flesh beneath them, they are red, blewish, &c. And therefore Physicians are wont to observe the Colour of the

Nails ; for the Nails, for examples sake, grow pale when the heat of the Heart is deficient ; in such as are at deaths door they are livid and brown. Those same white spots which in yong people sometimes appear in their Nails, spring from a vigorous heat, which drives hidden Excrements to the Nails, and separates them from others of a different Nature.

They are knit about the Root with a Ligament, and Skin grows about them without ; and flesh grows under them, or rather the tendons of Muscles, there dilated : there is therefore in that place an exquisite sense, and great pain when they are hurt.

And so much may suffice to have spoken of the Nails, breifly, and by way of Compendium.

Chap. II. Of the Muscles of the Humerus, or of the Brachium, peculiarly so called.

THE common containing Parts being removed, viz. the Scarf-skin, the Skin, the Fat, the *Membrana carnea*, &c. the MUSCLES shew themselves, by which the motion is made, of which I am to treat in this whole Book ; in a convenient place, though *Hafman* think otherwise, especially because the Doctrine of the Muscles is useful and necessary, by reason of Issues, Wounds, &c. And in the other parts they could not be treated off.

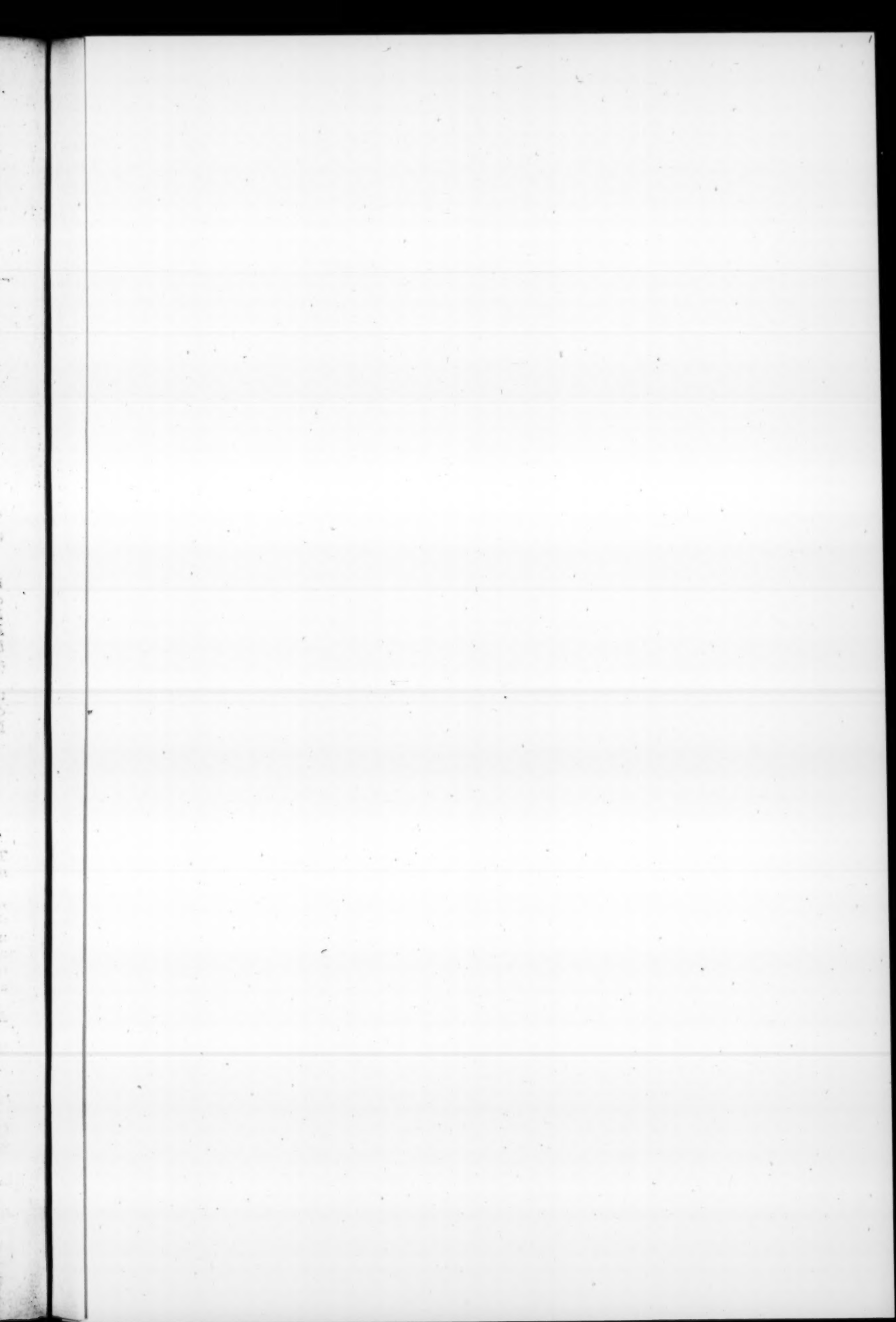
Now touching the action of the Muscles of the Arm in general, it is to be noted, that the inner Muscles do mostly serve to bend, and the outer to extend. And in the whole Arm the internal Muscles are more and stronger then the external, because bending is more worthy then the extension.

The *Humerus* is variously moved, and therefore it hath fundry Muscles, partly lying upon the Chest, and partly growing to the *Scapula* or Shoulder-blades, &c. Some reckon them seven, others

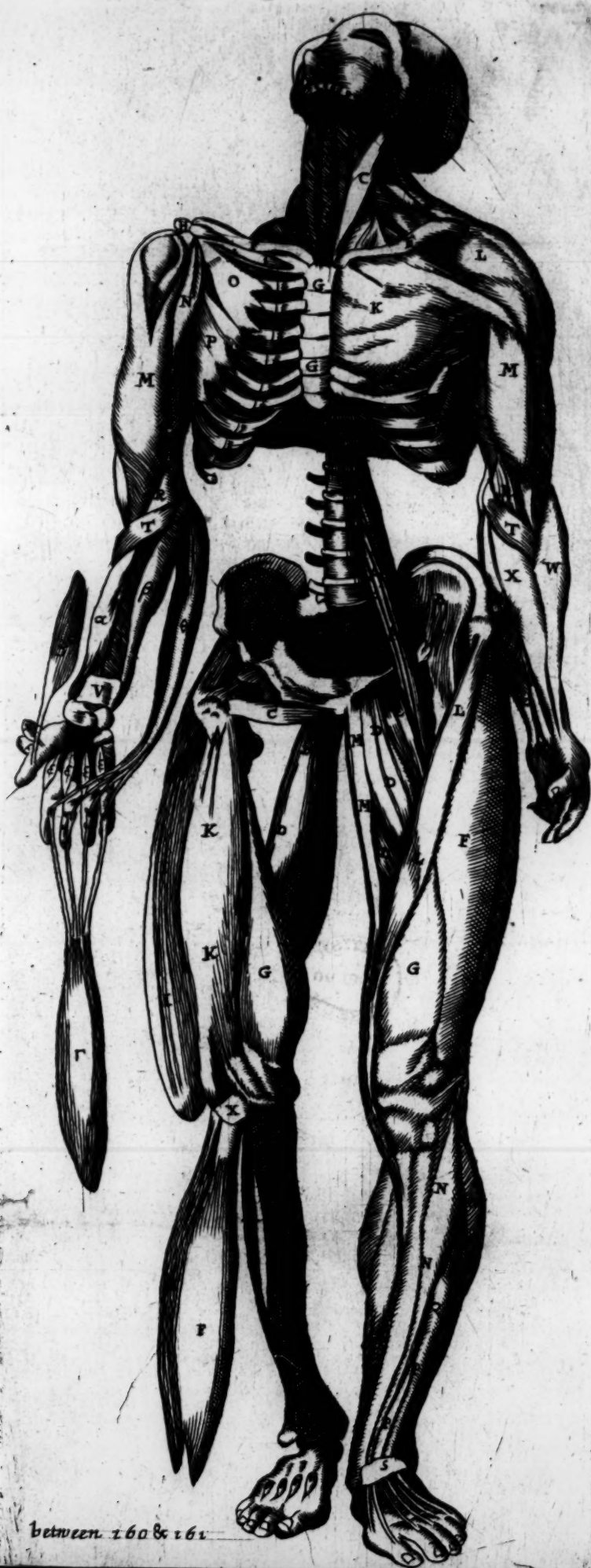
Colour of the Nails and signs from thence.

Whence the sense of the nails proceeds

The Muscles of the Humerus how many ?







there eight and *Casseri* nine. For the Arm is said to be lift up by two Muscles, *Deltoides* and *Supra-spinatus*; and downwards by two, the *Ani scapular* and *Rotundus major*: forwards by one alone, viz. the *Pectoralis*; backwards by three, the *Infra-spinatus* and *Sub-scapularis*, and the *Transversus brevis*. But they conceive the circular motion thereof is caused by all of them acting one after another: but others will have the Arm to be wheeled about by the *Infra-spinatus*, *Supra-spinatus*, and *Sub-scapularis*. But I shall in recounting them follow the order of Dissection.

The first is termed *Pectoralis*, because it takes up the Breast or forepart of the Chest being great and fleshy; which *Galen* conceived might be divided into three or four.

It arises from wellnigh the whole Breast-bone, and the Gristles thereto annexed; where it is a little tendinous in part of the *Clavicula*, and the fifth, sixth and seventh true Ribs. 'Tis implanted with a short, broad Nervous and strong tendon, into the Os *Humeri*, between the *Deltoides* and the *Biceps*.

Its Use is, to move the Arm to the Breast, and as the Fibres are contracted more to the upper or lower part or right forward, so doth the Arm incline this way or that way. This is the Muscle which suffers in that torment which the Italians call *Tratta de corda*, the *Strappado*. For it is very much haled and drawn

a sunder, when the Arms are pulled forcibly backwards.

The second is called *Deltoides*, from its likeness to the Greek letter Δ also *Triangularis Humeralis*, which is fleshy and so abides, and is spread upon the Head of the Shoulder.

It arises from the middle of the *Clavicula*, looking towards the *Scapula*, and from the top of the *Humerus*, with a fleshy end indeed, but yet a strong tendon lies concealed therein.

Its Use is to lift up the Arm. In the middle hereof the Ancients were wont to make Fontanels or Issues; but others in the external part of the said Muscles: but an Issue is better made in the space between the *Deltoides* and the *Biceps*, as I shew in my *Treatise of Issues*, because 1. There is the *Cephalick* or Head Vein. 2. It is between two Muscles. 3. It may be very well seen and dressed by the Patient. Now the place is exactly found below the Shoulder joint, four or five Fingers breadth, where when you bend the Arm you may feel the space between the two Muscles, and the Arm being lift up, it is Circumscribed in fat persons with a small Cavity, as *Claudius*, *Solenander* and others observe. *Ferrus* measures four Fingers breadth from the Elbow upwards. See also *Glandorp*.

The FIGURE Explained.

This TABLE represents all the Muscles of the Body described by the Authour, which are to be seen before.

AA. The Muscles of the Neck, called *Musculi longi*.
B. The Muscles *Scaleni*.
C. The Muscle *Mastoides* which bends the Head.
dd. The Vertebra's of the Neck.
E. The Levator *Scapulae*, lifter of the Shoulder.
FF. The *Claviculae* or Chanel bones.
G. The Breast-bone, call'd *Sternum*.
H. The Acromion or Shoulder-tip.
ii. The *Musculus Subclavius*.
K. The *Pectoral* Muscle.
L. The Muscles *Deltoides*.
MM. The Muscle *Biceps*.
N. The *Musculus perforatus*, or bored Muscle.
O. The *Serratus minor*, or smaller-saw-muscle.
PP. The greater Saw-muscle, or *Serratus ma* or.
qqqq. The *Intercostal* or Rib between Muscles.
RRRR. The branchia's on each Arm, conspicuous from

each part of the *Biceps*.
SS. The first Arm extender, or the *Longus*.
TT. The *Musculus Radij pronator rotundus*.
V. *Radij Pronator Quadratus*.
W. *Supinator Radij primus*.
X. *Carpi flexor primus* or *externus*.
Y. *Musculus palmaris*.
Z. *Carpi flexor alter*, or the *internus*.
a. The Os *Radij*.
b. The Os *Cubiti*.
J. The Ligament which fastens the *Cubitus* to the *Radium*.
G. The *Digitorum flexor sublimis* or *Perforatus*.
O. The *Profundus* or *Perforans*, under the former.
ccc. The *Musculi Lumbicales*.
c. The *Flexor pollicis* or Thumb-bender.
xx. The Muscles which draw the Thumb towards the Hand.

The following Characters serve to point out those Muscles; which run out from the Region of the Loyns to the End of the Feet, in the forepart of the Body.

A. The Muscle *Psoas* or *Lumbaris*.
B. The Muscle *Iliacus*.
C. The *Obturator internus*.
DDDD. The *Musculus Triceps*, or Tripple-headed Muscle.
EE. The *Musculus Ilioides*.
FF. The *Rectus* in its situation, but on the right Leg hanging by its End.
GG. The *Vastus internus*.
H. The *Vastus externus*, which on the right Leg hangs separated.
II. The *Musculus membranaceus*, or the *Fascia lata*.
KK. The *Musculus Crureus*.
LL. The *Musculus longus*, *Fascialis* or *Sartorius*.

MM. The *Musculus gracilis*.
NN. The *Musculus tibiens anticus*.
O. The *Musculus peroneus Biceps*.
PP. The Muscle which extends the four Toes of the Foot.
Q. The Muscle which extends the great Toe.
R. The *Musculus Gastrocnemius*.
rrrr. The *Musculi Interossei*.
S. The transverse Ligament of the Foot.
T. The Tibia.
V. The Fibula.
X. The Patella.

The third is broadest of all, and with its fellow covers almost the whole Back. 'Tis called *Ani Scalptor*, *Claw-breech*, because it draws the Arm backwards and downwards.

It arises with a membranous and very broad beginning, from the points of the Vertebra's of the Back bone, from the *Osfacum* and *Ilium*, as far as to the fix. Vertebra of the Chest. It is inserted between the Pectoral and the round Muscle, with a strong, short and broad Tendon. Its shape is triangular.

Fallopian out of *Galen* against *Vesalius*, doth teach that this Muscle is furnished with a new, but very small beginning, while from the lower Corner of the Shoulder-blades, it receives very many fleshy Fibres. This Muscle because it hath a large beginning, and therefore divers Fibres; according as they are variously contracted, so the Shoulder is either drawn more upwards or depressed more downwards. And because it also passes through the lower corner of the Shoulder blade therefore it lightly draws the same also away with the Shoulder.

The fourth is called *Rotundus major*, and it is obliquely seated behind, under the Axilla, being fleshy, thick, and rounder then the rest.

It arises fleshy from the Rib of the lower Scapula, and ascending a little with its tendon, short, broad, and strong, it is implanted with the Pectoral, into the upper and lower part of the *Humerus*.

Its Use is, to draw the Arm downwards and backwards, and to work contrary to the *Deltoides*.

The first is short and round; quite fleshy, which arises with a sharp beginning out of the lowest corner of the Scapula; after it grows thicker and thicker to the middle of its belly, and thence growing smaller by little and little, it terminates with an acute end into that Ligament, wherewith the Head of the Shoulder is involved.

It hath an oblique Situation, and some call it *Transversus musculus brevior*, others *Rotundus minor*. And it is the eighth in *Fallopian* his account: which Muscle others suppose to be a certain portion of the fourth.

The sixth is called *Infra-spinatus*, also *Suprascapularis inferior*, because it covers the whole external bunching part of the Scapula, whose form also it bears; but becoming more narrow, it is with a broad and short Ligament inserted into the Shoulder.

It is thought to wheel the Arm backwards and outwards.

The seventh is the *Supraspinatus*, also *Suprascapularis superior*, also *Rotundus minor*; it is fleshy and somewhat longish, over the Armpit; it fills the Cavity between the upper Rib of the scapula, and the Spina thereof, out of which it grows.

Now it is inserted with a broad and strong tendon, into the Neck of the *Humerus*, at the Ligament of the joint, being carried above the first joint.

The Use of this is thought to be the same with that of the former. Others conceive it moves upwards with the *Deltoides*.

The eighth is termed *Subscapularis* or *Immersus*; being very fleshy, it quarters betwixt the Scapula and the Ribs, and takes up the inner part of the Scapula; but it is inserted with a broad tendon, internally, into the second Ligament of the *Humerus*.

Its Use is to bring about the Arm inwards.

The ninth Muscle was first observed by *Arantius* and *Placentinus*, being in the former part of the Arm and called *Perforatus*.

It arises from the *Coracohumeral Processus* of the Scapula

(and is therefore by *Riolanus* called *Coracoideus*, or *Coracobrachialis*) it is inserted into the inner part of the Shoulder about the middle, by the tendon of the *Deltoides*. It hath a beginning nervous and short, a long round Belly sufficiently corpulent, and a strong tendon. Its Belly hath an hole bored in it, and gives passage to the Nerves, which are distributed to the Muscles of the Cubit. This Muscle others have only termed a muscular Portion of the Biceps.

'Tis useful to draw the Arm to the Process of the Scapula; or draw it set ward upon the Breast.

Chap. 3. Of the Muscles of the Scapula or Shoulder-blade.

BECAUSE the Scapula is moved forward and backward; upward, and downward; therefore it hath received four Muscles. To which nevertheless others add two more, *The Error of our viz. the Serratus major and the Digastric Anatomists.* *stricus*, but they do not well. For the later is proper to the *Oshyoides*, the former to the Chest.

I. The first is called *SERRATUS MINOR*, and it is spread under the *Musculus pectoralis*.

It arises from the four upper Ribs, excepting the first and ascending obliquely upwards, with an end partly fleshy, and partly tendinous, it is inserted into the Scapula by the *Processus anconiformis*.

Its Use is to draw forward into the Breast.

II. The second is by *Galen* called *Trapezius*, others term it *Cucullaris*, because it resembles a Friars Cowl. But that this Muscle was given our first Parents, as the Badge of a religious life, as *Riolanus* conjectures, I do not believe, because others are religious that wear no Cowles, and many are irreligious that wear them, whether you look at their Profession or Manners. However this Name was given this Muscle by Christian Physicians; because of its likeness to a Monks Cowl.

It arises fleshy and thin from the hinder-part of the Head. From whence it descends to the eighth Vertebra of the Chest, and from thence as also from the hinder part of the Head growing small by little and little, it is inserted into the Back-bone, the Scapula, the top of the Shoulder and the Clavicula.

But because of its various Original and various Fibres,

It variously moves the Scapula, upwards, obliquely, by reason of Fibres obliquely descending from the hind-part of the head to the *Omo-plata*, which *Riolanus* denies in vain; downwards, by reason of the carriage of fibres, ascending from the eighth Vertebra of the Back; and right out to the Back, by reason of right fibres in the middle of the Muscle, stretched out to the Scapula.

III. The third is the *Rhomboideus* from its figure like a Diamond, situate under the *Cucullaris*, thin and broad.

It arises from the three lower Vertebra's of the Neck and the three upper Vertebra's of the Chest, and with the same latitude is inserted into the Basis of the Scapula.

Its Use is to draw back a little obliquely upwards.

IV. Is the *Levator*, which others call the Muscle of Patience; because those whose Affairs go cross, are wont to lift up their Shoulders: it is above the Clavicula.

It arises from the five transverse Processes of the Vertebra's of the Neck, with sundry beginnings (which makes

makes it seem divers Muscles) which soon grow into one: and its *Insertion* is in the higher and lower corner of the Scapula, with a broad and fleshy tendon. Its *Use* is, to draw forward and lift up the Scapula and the Humerus.

With these Muscles the Scapula is moved directly or of it self, and the *Brachium per accidens*, accidentally; as the Scapula is accidentally moved by the Muscles of the Brachium.

Chap. 4. Of the Muscles of the Chest, or which serve for Respiration.

VERY many Muscles serve for Respiration; as the Midriff, all the Intercostal Muscles, some of the Belly (of which I have treated in the first and second Book) and some

Proper to the CHEST, which are reckoned on each side six; to which nevertheless Fallopius adds three in the Neck; which in *Vesalius* are parts of Muscles possessing the Breast and Back.

The proper Muscles of the Chest do grow thereto: two in the forepart, *subclavius* and *triangularis*; *Serratus major* possesses the Sides; the rest are in the hinderpart, viz. the two *Serrati postici* and the *Sacrolumbus*.

I. THE *SUBCLAVIUS*, because 'tis seated under the Clavicula, fills the place between it and the first Rib. *Platerus* reckons it amongst the Intercostals.

It *arises* fleshy from the inner and lower part of the Clavicula: it is *inserted* fleshy into the upper part of the first Rib, which it draws upwards and outwards. And this is the first muscle which dilates or distends the Chest. To this *Spigelius* assigns a contrary use, viz. to draw the Clavicula downwards; which nevertheless is of it self immovable, and therefore he ascribes thereunto a Rise and an Insertion contrary to it.

II. THE *SERRATUS MAJOR*, is a great, broad, and every way fleshy muscle, with the oblique descendent of the Abdomen, it makes a Saw-like Combination.

It *arises* fleshy, from the internal Basis of the Scapula. *Riolanus* hath observed an higher Original thereof, from the two upper Ribs, as far as to the Clavicula, which two Ribs seem immovable. It is *carried* by its tendon, with five unequal ends, to the five true Ribs, and sometimes to two bastard Ribs; which it lifts up. *Spigelius* also and *Veslingus* do ascribe a contrary Use hereunto, and consequently a contrary Original, and Insertion.

III. *SERRATUS POSTICUS SUPERIOR minor*, does quarter under the Rhomboides in the Back, between the two Shoulder-blades.

It *arises* membranous from the lower Spines of the Neck, and the first of the Back: it is *inserted* into the three Intervals of the four upper Ribs, being tripartite: and it draws those Ribs upwards.

IV. *SERRATUS POSTICUS INFERIOR major*, is membranous and broad almost in the middle of the Back, under the *Musculus latissimus* or *Ani scalptor* *arising* from the Spines or sharp points of the lower Vertebra's of the Back. It is *inserted* into the Intervals of the four lower Ribs, being parted as it were into Fingers. Its *Use* is to widen the lower part of the Chest.

V. Is spread under the former, and by others supposed to be common to the Back and Chest. 'Tis called *SACROLUMBUS*, because it *arises* from the lower part of Os sacrum, and the sharp points of the Verte-

bra's of the Loins. It is fleshy within, nervous without. It is *inserted* into the lower Ribs, with a double tendon, one external which is strongest, the other internal. It is not easily separated from the lowest muscle of the Back, so that it seems to be a parcel thereof. Its *Use* according to *Veslingus*, to contract the Chest. *Spigelius* conceives as I do, that because it grows out of one beginning with the *Musculus longissimus* of the Back, that therefore it extends and raises up the Chest.

VI. Is the *TRIANGULARIS*, small and subtile, in lean persons scarce fleshy, it lies inwardly concealed under the Breast-bone, out of the lower part whereof, it hath its Original. And therefore it may conveniently be called the Muscle of the Breast-bone. Its obliquely *inserted* into the lower Griftles, which it draws to, and straitens the Chest.

Chap. V. Of the Muscles of the Head.

THE HEAD is moved, either secondarily by the muscles of the Neck, according to the motion thereof; or primarily upon the first Vertebra, to which it is immediately and closely joyned, being bent forward and backward. It is turned round upon the tooth-fashioned Process of the second Vertebra (on which the hind-part of the Head rests, and to which it is firmly fastned) as it were upon an Axle-tree; which motion is performed by nine pare of Muscles.

The first pare is long and thick, by some called *Splenium*, spread out on each side upon the Vertebra. It *arises* from a double beginning, one from the Spinæ of the upper Vertebra's of the Chest, another from the five lower Spinæ of the Vertebra's of the Neck, from which it is carried to the middle of the Occiput. Its *Use* is, to draw the Head directly backwards. But if only one do act, the motion is thought to be made circularly to one side.

The second is implicated and complicated, and therefore termed *Complexum*. It seems to consist as it were of three Muscles. It hath divers beginnings, at the seventh Vertebra of the Neck, at the first, third and fourth of the Chest, and it is after a different manner implanted into the Occiput.

Riolanus observes touching the Fibres of the *Splenium* and the *Complexus*, that they are cross-ways intersected, and disposed for the strength of both the Muscles.

The third Pare is situate under the second, small and thick, which *Vesalius* would have to be the fourth part of the former Muscle. It is *inserted* into the hindermore Root of the *Processus mammillaris*. Its *Use* is, lightly to bring the Head backwards; and if but one act, to bring it backwards to one side.

The fourth pare is called *Rectum majus*, being small, fleshy and lean. It *arises* from the second Vertebra of the Neck; ends into the middle of the Occiput.

The fifth pare called *Rectum minus*, lies concealed under the former pare. Its *Rise* is from the first Vertebra of the Neck, its insertion and *Use* is as of the third and fourth.

The sixth is the *Obliquum superius*, which lies also beneath. It *rises* according to some, out of the middle of the Occiput, and descending is inserted athwart, into the points of the Processes of the Neck. But others among whom *Veslingus* do rightly think it *arises* from the Process of the first Vertebra, and ends into the Occiput.

caput, by the outward side of the Recti.

The *seventh* called *Obliquus inferius*, arises from the second Vertebra of the Neck, and is inserted into the transverse Process of the first Vertebra.

The Use of the two oblique Muscles, is to bring the Head about to the Sides.

The *eighth* called *Mastoides*, arises long and round in the forepart of the Neck, for the most part double, from the upper part of the Breast-bone and the Clavicle: it is inserted with a fleshy and thick End, into the Mamillary Process, which it embraces. Its Use is to turn the Head.

A *ninth* part is added by *Fallopini*, under the Throat, in the forepart of the Neck, lying near the first part of the Neck. It arises nervous from the Ligaments of the Vertebra of the Neck, and is inserted into the Basis of the Head, which it turns in like manner with the former.

Chap. 6. Of the Muscles of the Neck.

THE Muscles of the Neck are on each side *four*. The two first extend, the two others do bend the same.

I. The two LONG ONES, lie hid under the Oesophagus or Gullet, arising from the first Vertebra of the Chest, with a beginning fleshy and sharp, they ascend into the tubercular Process of the first Vertebra, with an acute tendon, and sometimes are inserted into the Occiput, near its great Hole.

Its Use is, to bend the Neck right forwards and the Head withal: and if but one act, it turns it on the one side.

The SCALENI so called, which some count Muscles of the Chest, have a peculiar Hole, through which Veins and Arteries enter into the Arms. They arise

fleshy, at the side of the Neck, from the first Rib; they are inserted inwardly into all the Vertebra's for the most part of the Neck, and especially into their transverse Processes.

III. The TRANSVERSALES *duo*, seated in the back, do rise from the six Vertebra's of the Chest which are uppermost and outmost: they are inserted externally into all the transverse Processes of the Vertebra's of the Neck. And between these Nerves go our. Their Use is, to extend or to bend backwards, but if one act alone, to move obliquely.

IV. The two SPINATI possess the whole Neck between the Spine, and are long and large. They arise from five Spines of the Vertebra's of the Neck, and seven of the Chest. They are strongly implanted into the whole lower part of the Spine of the second Vertebra. Their Use is the same as of the third part.

Chap. 7. Of the Muscles of the Back and Loins.

THE spine of the Back or Back-bone is moved forward, backward, to the right and to the left, and circularly. Yea, and in tumblers we may see infinite motions of the Back. For tendons are brought to all the Vertebra's, as though the Muscles were many and infinite; which tendons nevertheless many Anatomists do refer to some one great Muscle, and say that one Muscle hath many tendons. But commonly, they make four pair of Muscles of the back: where it is to be observed, if only one act, the back-bone is moved side-ways, if the pair acts, it is either bended or extended.

The first pair is termed QUADRATUM, adhering to the transverse Processes of the Vertebra's of the Loins;

The FIGURE Explained.

This TABLE presents certain Muscles which do first offer themselves to sight, in the Hinder-part of the Body.

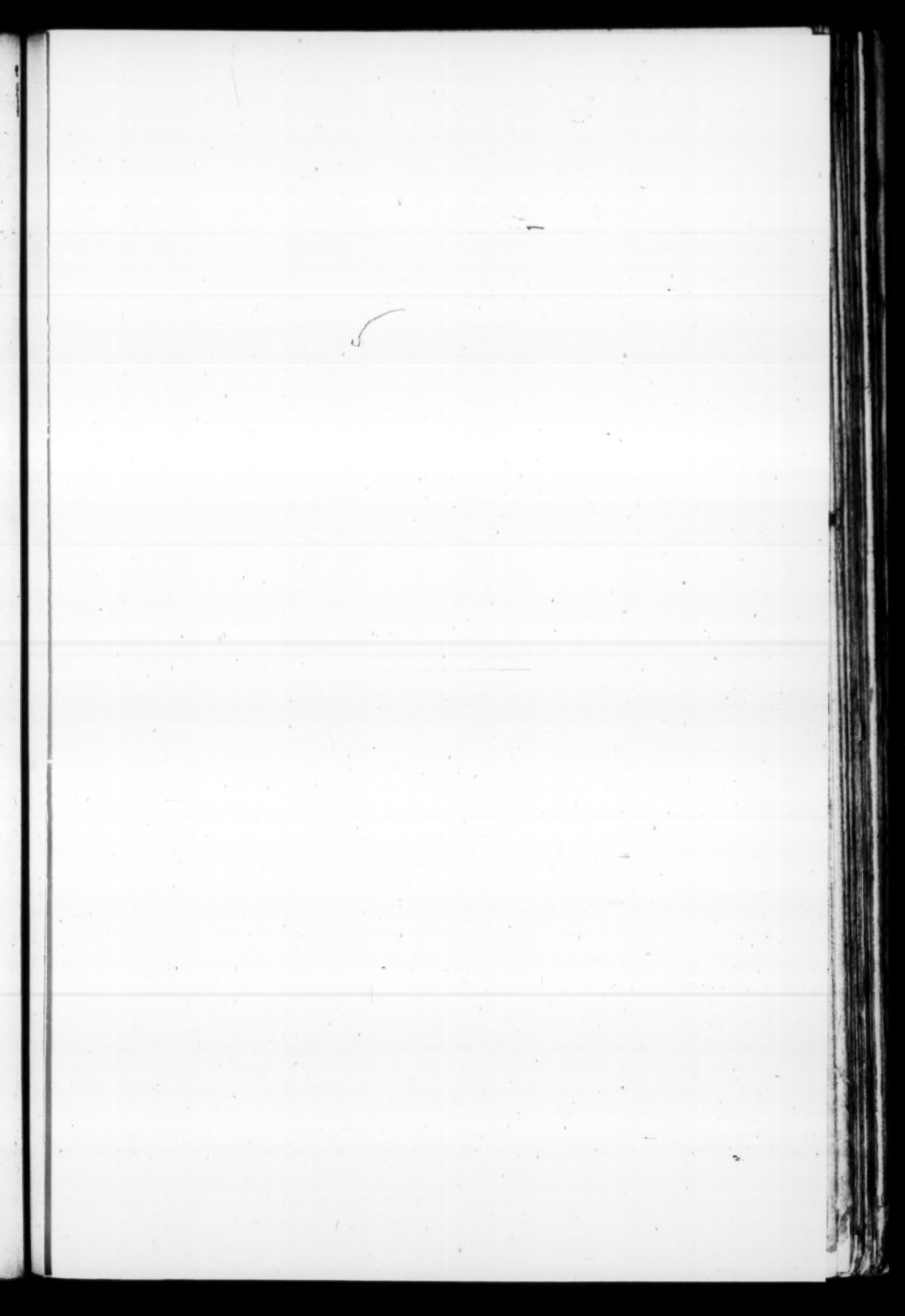
- aa. The Muscles of the Head called Complexi.
- BB. The Muscles called Splenij.
- CC. The two Levators Scapulae.
- D. The Trapezius or Cucullaris out of its place.
- E. The Supra-spinatus.
- F. The Infra-spinatus.
- G. The Rotundus major.
- h. The Rotundus minor.
- II. The Rhomboides.
- KK. The Dorsi latissimus.
- L. The Serratus posticus superior.
- M. The Serratus posticus inferior.
- NN. The Dorsi longissimus.

- OO. The Sacrolumbus.
- P. The Quadratus.
- Q. The Sacer Dorsi musculus.
- R. The Musculus longus which extends the Arm.
- S. The Musculus brevis, the other Arm-extender.
- TT. The Supinator Brachij alter, according to our Authors, see the first part in the next Table.
- V. The Extensor Carpi primus, which some term Bicornis.
- W. The Extensor Carpi secundus. (here hanging down.)
- XXxx. The two Extensores Digitorum.
- Z. The External Apophysis of the Shoulder.
- Δ. The Deltoides.
- T. The Brachieus.

These following Characters demonstrate the Muscles of the lower Limbs]

- A. The Gluteus major out of its place.
- B. The Gluteus medius in its place.
- C. The Pyramiformis Musculus.
- D. The Obenratus internus or Marfipialis.
- EE. The Biceps which bends the Leg.
- g. The Semipervosus.
- hh. The Gracilis.
- III. The Triceps of the left Side.

- K. The Vastus externus.
- ΔΔΔ. The Triceps of the right Side.
- LL. The Popliteus.
- MM. The two, Castrocnemij, which on the left side are in their proper Situation, on the right side out of it.
- NN. The Musculus soleus.
- O. The Musculus plantaris.







arising inwardly from the Bones Ilium and Sacrum, broad and fleshy. *Riolanus* would rather bring them from the transverse Apophyses, of the two lower Vertebra's of the Back, and the last Rib, that it might with the oblique descending Muscles and the right ones, agitate and move forwards the Fabrick of the *Ossa Ilij*. Howbeit, seeing that *Hypothesis* is as yet uncertain, and himself confesses with *Cajus*, that the business is to be understood, of the bowing of the Loins, and the frame of the Iliac Bones; according to the Original by me assigned, the Use of this Muscle is rather to bend the Vertebra's of the Loins.

The second being called *LONGISSIMUM*, arises with an acute and strong Tendon, without tendinous, with fleshy, from the end of *Os sacrum*, the Vertebra's of the Loins, and the *Os Ilij*; having the same beginning with the *Sacrospinalis*, wherewith it is in a manner confounded, till in the Progress it is separated therefrom, by the lowest Vertebra of the Back. And it is joyned afterward to each transverse process of the Vertebra's of the Loins and Back, unto which it affords tendons like *Clasps*, and at length ends sometimes into the first Vertebra of the Chest, sometimes at the mammillary processes, near the Temples-bone. Its Use is, to extend the Chest, Loins, and their Vertebra's.

The third under this, is that which is called *SACRUM*, because it arises from the *Os sacrum* behind, being fleshy, and ends into the Spina of the twelfth Vertebra of the Chest (or as others say, into the Spines also, and oblique processes of the Vertebra's of the Loins) with sundry tendons. The Use is as of the former.

The fourth the *SEMI-SPINATUM*, arising where the former ends, and embracing all the Spines of the Vertebra's of the Chest, and giving them tendons; and it ends into the Spine of the first Vertebra of the Chest. Its Use is to rear up the Chest.

If all eight act, they hold the Back straight, and do as it were sustain a man. Nor are there any muscles of the Loins, save these, and what have been explained before, which I have omitted, as *Riolanus* objects, or whereof I have been ignorant.

Chap. 8. Of the Muscles of the Cubitus and Radius.

An Order in Dissection.

THE Muscles of the CUBIT, according to the arbitrary Method of Dissection follow. Yet I do advise the Dissector, that the Muscles of the Radius are not to be shewed immediately after these, but last of all; but after the Muscles of the Cubit, those of the fingers, thumb and wrist; because the Muscles of these parts being shewn and removed, the Insertions of the Muscles of the Radius, are more conveniently discerned. Otherwise the Brachium may follow next after the demonstration of the Muscles of the Cubitus and Radius, by an Order free for any one to follow.

The Muscles of the Cubit are four, and of the Radius as many.

There are two Benders of the Cubit, as the *Biceps* and *Brachialis*: two Extenders, viz. the *Longus* and the *Brevis*.

There are two Pronators of the Radius, the *Rotundus* and the *Quadratus*, and two Supinators, the *Longus* and *Brevior*.

For the proper Motion of the Cubit is flexion and extension. But the Radius makes the whole Arm prone or supine.

The first of the Cubit is termed *BICEPS*; because of its double distinct Beginning, which is from the Scapula, the one tendinous and round, from the upper lip of the Acromion, the other broader and less tendinous, from the *Processus anconiformis*. And it is inserted with the Head of the Radius, and possesses the inner part of the Arm with its Body. The tendon of this Muscle ought in Blood-letting to be taken heed of.

The second lying under this, and spread out upon the bone it self, being short, is called *BRACHIALIS*; 'tis all fleshy, less then the former; arises from the middle bone of the Brachium, and is before inserted into the common beginning of the Cubitus and Radius, and the Ligament of the Joynt.

The third is the *EXTENDENS PRIMUS* and *LONGUS*, it arises with a double beginning, from the lower Rib of the Scapula, is ended being fleshy in the Olecranon.

The fourth is the *EXTENDENS SECUNDUS* and *BREVIS*; it arises from the Neck of the Humerus, is behind mixed with the precedent, and occupies the *Os Humeri*; and it ends into the part of the Olecranon on which we lean.

Cassius adds a fifth called *tertius extendens*, which others count a portion of the fourth Muscle; but he counts it a distinct Muscle, as later Anatomists *Riolanus* and *Veslingius* do, which they term *Anconæus*. But he would have it to be a portion of his *Brachialis*, because it sticks sometimes close to the fleshy Extremity thereof, and to answer to the *Popliteus*, that an equality may be maintained between the foot and the hand. It springs out of the hinder extremity of the Shoulder, by the end of the fourth and third Muscle, and passing beyond the Joynt of the Cubit, it is also inserted by its hinder and lateral part, yet not above a finger's breadth beyond the Olecranon, into the *Os Cubiti*.

Moreover *Galen* seems to add a sixth, which is the fourth Extender, viz. a fleshy Lump huddled up of the two former, which *Riolanus* calls *Brachialis externus*, to difference it from the *Brachialis internus flexens*, because being spread out upon the outside of the Brachium, it is placed under the two former.

The first Muscle of the Radius is termed *ROTUNDUS*, or *Teres*; from the inner Apophysis of the Arm by a strong and fleshy beginning, it ends obliquely very near into the middle of the Radius, with a fleshy end, and likewise a membranous tendon, which *Spigelius* writes, does go again to the middle of the Radius, and is knit to the outward side of the said Radius.

The second *QUADRATUS*, reaching from the lowest part of the Cubit, into the lowest of the Radius, wholly fleshy, every where two fingers broad; it goes above that Ligament common to the Radius and Cubitus. These are the *Manus pronatores*.

The third is the *SUPINATOR PRIMUS*, from the lower part of the Brachium growing sharp, till it reach into the lower part of the Radius, fleshy, where it is inserted with a tendinous End.

The fourth is the *SUPINATOR ALTER*, growing from the outward Apophysis of the Arm, fleshy, membranous without, fleshy within, and is inserted into the middle well-near of the Radius.

Among the Muscles of the Radius *Cassius* once found two little ones, and very small, about the Joynt Cubit, and proceeding in an opposite fashion, and moving the Radius Prone and Supine like a Pulley. Howbeit, I found them not as yet. I have sometimes seen in their place, in a muscular man, one triangular Muscle,

Muscle, arising from the top of the Shoulder, and ending about the middle of the same, with a fleshy and narrow end, nor was it the portion of any Muscle, all which we had before diligently separated.

Chap. 9. Of the Muscles of the Wrist and Fingers.

TO the Muscles of the WRIST and the Hollow of the Hand, is the *Musculus PALMARIS* referred, arising from the inner Apophysis of the Arm, with a round and tendinous beginning, spread almost over all the Muscles of the Hand, it is stretched out over the Hollow of the Hand, and cleaves exceeding fast to the Skin: where under the Skin in the hollow of the hand is a broad Tendon; whence proceeds that exquisite Sense which is in that part: and it ends into the first Intervals between the Joints of the Fingers: it seems to have been made, that the Hand might take the better hold, when the Skin of the Palm is wrinkled.

To this they add the *Membrana carnea* which they will have to open the Palm of the Hand when it is contracted; also a *fourth square Parcel of Flesh* growing out of that Membrane, resembling certain Muscles; either to extend the Palm when the Hand is open, as *Spigelius* conceives, or to make it hollow, which *Riolanus* would have.

The Muscles of the Wrist or *CARPUS* are four; two *Benders* which are internal; two *Extenders*, which are external.

The first *Bender* (which *Riolanus* calls *Cubiteus internus*, to whom we are beholden for these Names) arising from the internal Apophysis of the Arm, and being stretched over the Elbow, it is implanted with a thick Tendon, into the fourth Bone of the Wrist.

The other, *Radius internus* because it is drawn along the Radius, arising from the same beginning, ends into the first Bone of the Metacarpium, under the forefinger.

The *Extensor primus*, or *Radius externus*, arises with a broad Beginning, from the external Apophysis of the Arm, and then growing more fleshy and spread out

The Explication of the FIGURE.

This TABLE shews the rest of the Muscles, which are visible in the Hinder-part of the Body, those which lay by them or over them being removed.

- aa. The Muscles of the Head called *Recti minores*.
- bb. The *Recti majores* so called.
- cc. The *obliqui Superiores*.
- dd. The *obliqui Inferiores*.
- e. The *Levator Scapulae*.
- f. The *Rotundus minor*.
- g. The *Serratus major*.
- EE. The *Musculi transversales* belonging to the Neck.
- fff. The *Spiram duo*.
- GG. The *Sacrolumbus*.
- HH. The *Dorsi longissimus* in its proper Situation.

- II. The same out of its place, that it may be seen.
- K. The *Semispinatus* of the Back.
- LL. The *sacer Musculus* of the Back.
- MM. The *Musculi Quadrati* of the Back.
- N. The first *Supinator Brachij*.
- O. The first *Extensor Carpi*, or the *Bicornis* out of its proper place.
- P. The other *Extensor Carpi*.
- QQ. The two *Extensores Digitorum* out of their place.
- R. The *Extensor Indicis*.
- SS. The two *Pollicem extendentes*.

These following Characters design the Muscles of the lower Limbs.

- A. The *Gluteus medius* out of its place.
- B. The *Gluteus minimus* in its place.
- CC. The same out of its place.
- DD. The *Piriformis* on both sides.
- E. The *Marsupialis*, or *Obturator internus*.
- F. The same in the left side out of its place.
- G. The *Marsupium* neatly expressed.
- HH. The *Obturator externus*.
- K. The fourth of the *Quadragemini*, by the Author called *Quadratus*.
- LL. The *Biceps* which bends the Leg.
- MM. The *Seminembranosus*.

- NN. The *Seminervosus*.
- OO. The *Gracilis*.
- Δ. The *Musculus triceps*.
- Γ. The *Cruentus*.
- PP. The *Tibialis posticus*.
- QQ. The *Flexor Digitorum Pedis, Magnus* or *Perforatus*.
- R. The *Flexor minor* or *Perforatus*.
- SSS. The *Flexor Pollicis*.
- t. The *Pollicis Adductor*.
- u. The *Pollicis Abductor*.
- x. The *Abductor minimi*.
- z. The fleshy Mass in the Sole of the Foot.

upon the Radius, and ends into a double Tendon, at the first and second Bone of the Metacarpus.

The other, *Cubiteus externus*, from the same beginning, through the length of the Cubit, goes with one Tendon into the fourth Bone of the Metacarpus under the little Finger.

The FINGERS are bended, extended, drawn to, and drawn away.

Bended by the Muscles *Sublimis* and *Profundus*.

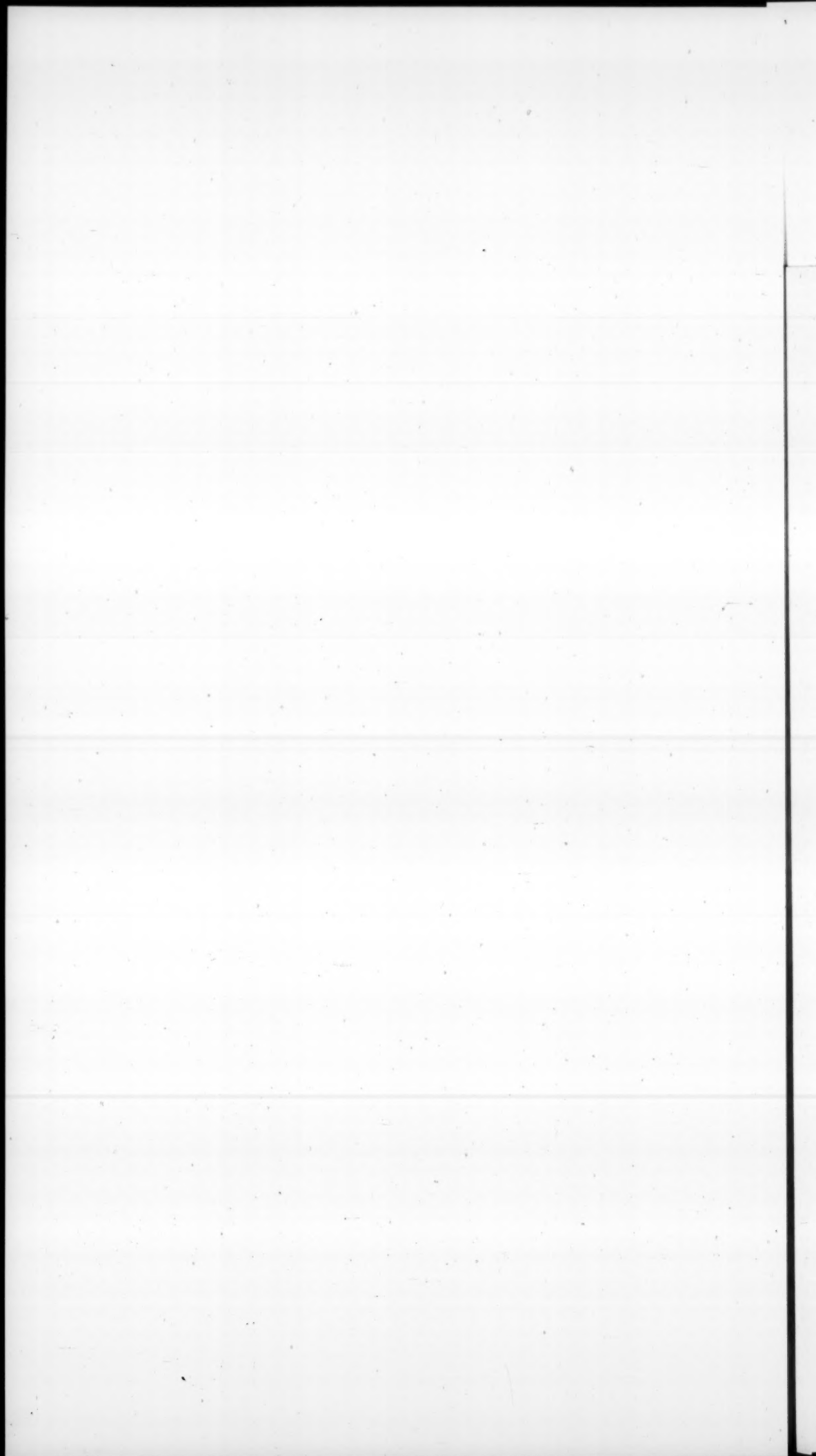
The former from the inner Apophysis of the Arm, before it comes to the Wrist, is divided into four Tendons, inclosed in a Ligament, as it were in a Ring:

they are inserted into the second Jointing of the Fingers, a Cleft being first made, which the Tendons of the following Muscle do pass through, whence it is termed *Perforatus*, the bored Muscle.

The later spread out under the former and like unto it, is inserted through the Cliffs of the former Tendons, into the Jointing. And therefore it is called *Perforans*, the Borer.

Concerning these Ligaments of the Fingers, it is to be observed. 1. That by an elegant Workmanship of Nature, a long slit is made in each of them, that the Ligaments of the third Jointing may pass through them







between 166 and 167

them as through an Arch. 2. That the membranous sheath does straitly embrace and keep in the said Tendons, least in the bending of the hand; they should be removed out of their place. 3. That a strong membranous Ring does in the wrist bind together all the Tendons internal and external, which being cut asunder, they are easily removed out of their places.

Jacobus Silvius reckons the *Extensores* for one Muscle; and calls it *Tensor Digitorum*, whereas both their Originals and Insertions do vary. They are two and arise commonly from the external Apophysis of the Arm, and the ring-fashioned ligament, and with their bored ligaments, being first collected, they are then inserted confusedly into the second and third joint.

The Fingers are drawn to by four muscles called *Lumbricales* or *Vermiculares* worm-fashioned muscles, from their shape and smallness. They arise from the tendons of the *Musculus profundus*, and being drawn out along the sides of the fingers, they are obliquely carried unto the third jointing. *Spigelius* and *Veslingius* will have them to be inserted by a round tendon only into the first jointing, whom I have sometimes found to be in the right, their tendon being mixed with the membranes of the interjuncture.

The *Abductores interossei* are six, in the spaces of the Metacarp, three external and three internal, which jointing with the vermicular do go along the out-sides and in-sides of the fingers, and stretch their tendons to the three inter-jointings. They serve in some measure for extension. The External rest upon the Palm, the Internal upon the hollow of the Hand, between the bones of the Metacarp.

The Muscles which bend the Thumb are two.

The first arising from the upper part of the radius is inserted into one of the joints.

The other arising from the wrist bone, under the Thumb, is inserted into the middle of the said Thumb. It lies wholly under the former.

There are two *Extendentes* or stretchers out, which arise from the Cubit. The first reaches unto the third Interjuncture, the other unto the second, and the rest, with many tendons; sometimes one, sometimes two, and otherwhiles three.

The *Abducentes* are three; two arising from the Metacarpium, and the third from the bone of the Metacarp, which looks towards the forefinger: which *Riolanus* calls *Alutibenas*, as the other the former of the bringers to, *Hypotibenas Pollicis*.

The *Abducentes* or drawers away are three nameless muscles, save that the said *Riolanus* calls one of them *Thenar*.

The Forefinger has two proper muscles, which I otherwise confound, the first is the Abductor, arising from the first Interjointing of the Thumb, and terminated into the bones of the Forefinger, wherewith the said Forefinger is drawn from the rest of the Fingers, towards the Thumb.

The other is the *Indicis extensor* the stretcher of the Forefinger which *Riolanus* calls *Indicatorium* the pointer, as also *Veslingius*, though he confound it with the Abductor. It arises from the middle and external part of the Cubit, and ends with a double tendon, into the second interjointure of the forefinger.

There are also two muscles proper to the smallest finger, the *Abductor* and *Extensor*. The former may be parted into many: It arises in the hollow of the hand, from the third and fourth wrist bones of the second rank, and ends externally into the side of the first joint of the said finger. *Aquapendens* and others that have since followed him, do hold that it draws the little fin-

ger outwardly, from the rest. *Extensor proprius*, which *Riolanus* exactly separates from the great one, arising from the upper part of the radius, and carried along Cubitus and the Radius, is externally inserted into the finger, with a double tendon.

Chap. 10. Of the Legg and Thigh in generall.

PES the Leg and Thigh, is all between the Buttocks and the Toes of the Feet: Others call it *magnus pes*, the great Foot, and *Crus*. It is divided into its parts, as the Arm, in a manner not unlike, viz. Into the *Femur*, *Tibia*, and *Parvus Pes*.

Again the *Parvus Pes* is divided into *Pedum*, *Metapedium*, and *Digiti*.

The Use of the Leg and Thigh, is to be the Instrument of walking: which is performed by stirring and sitting. For one Leg being firstly set upon the ground, we move and bring about the other, and our Foot being firmly fixt, keeps us from falling: and so we come to walk. The setting therefore of our Leg is the Motion of the whole Body, but the motion proceeds from the Leg, which the length or shortness of the Leg does either help or hinder; and therefore birds because they were to fly, that their bulk might not hinder them, they have a short Thigh and long Feet, which makes the going be slow. But Men go slower than Dogs, because the successive putting on of their Foot from the Heel to the Toes, slackens their motion; whereas Dogs with one motion of their little Feet do pass along. Some do conceive that the length of a womans Leg helps to generation. Now there is an Incision made into our knees and heel, that we might not go leaping.

This Motion is variously made by the muscles of the Thigh, Leg and Foot. We are therefore now to treat of the Muscles of the whole Leg.

Chap. 11. Of the Muscles of the Thigh.

THe Thigh is bended by two Muscles.

The first is in the Belly, and is termed *Psoa* or the *Musculus Lumbaris* it arises with a fleshy beginning from the upper Vertebrae of the Loins, and is inserted into the forepart of the small Trochanter, with a round and strong tendon.

The other muscle called *Psoas minor* I found in a strong fleshy body at *Hastua*, 1651. differing from that which *Riolanus* brags to have seen. For the greater part lay under, but outwardly inclined more to the sides. The beginning was fleshy, and the whole muscle was three fingers broad. It was inserted fleshy, into the upper brim of *Os Ilij* backwards, where the *Iliacus internus* arises. I conceived that its use was to spread as a pillow under the greater muscle, because the *Os Ilij* is of it self immovable, or to hold the *Os Ilij* upright, that it might not burthen a man too much when he stands. *Michael Lyserus* a most expert Anatomist can witness the same with me.

The *Iliacus secundus* is inserted in the same place, with a tendon which grows to the tendon of the precedent muscle, arising from the whole internal cavity of the *Os Ilij*, by a small and fleshy beginning.

The

The Thigh is extended by three muscles of the Buttocks termed *Glutei*.

I. Is the *Major, externus & amplissimus*, beginning at the Crupper, the Spina of Os Ilii, and the Os sacrum; and ends into the Os Femoris, under the great Trochanter.

II. The other is the *medius* or middlemost in Situation and Magnitude. It arises from the inner side of the Spina of Os Ilii, ending into this great Trochanter with a broad and strong tendon.

III. The third called *minor* is the smallest, lies concealed under the middlemost; It arises from the back of Os Ilii near the Acetabulum with a broad and strong tendon, and ends into the great Trochanter.

These three do make up the fleshy Substance of the Buttocks.

The Thigh is drawn to, and wheeled about inwards by three muscles, which many do reckon for one, and call it *triceps* triple headed, because of its threefold beginning. 1. Is from the upper joynting of the Os pubis. 2. Is from the lowest joynting of Os pubis. 3. Is from the middle part of the said bone. They are inserted first of all into the inner head of the Thigh bone, near the Ham, with a round tendon or into the rough line of the Thigh. 2. To the upper, partly. 3. Partly to the lower, at the Rotator minor. *Riolanus* has other insertions: For he will have the first to be inserted into the middle of the Thigh, the second to be produced with a very strong Tendon as far as to the End of the Thigh, the third below the neck of the Thigh-bone.

To these *Spigelius* and *Veslingus* do add one which they call *Lividus* arising at the joyning of Os pubis, near the Gristle, and implanted with a short tendon, into the inner side of the thigh: but they grant that this is a portion of the *Triceps*. But they do ill to reckon it among the bending Muscles. But *Riolanus* calls it *Pectineus* and reckons it for a bender, yet acknowledges that it is the uppermost and fourth portion of the *triceps*, which with *Fallopius* he divides into four Muscles, and indeed it seems to have so many parts.

It is drawn away and turned about outwards by six Muscles, the *Quadrigemini* and the two *Obturatores*.

The *Quadrigemini* are in a manner one like another, and little, placed as it were athwart, arising from the lower and outer part of the Os Sacrum, the bunch of Os Ischij, and the Appendix of the Hip-bone. They are inserted into that space which is between the two Trochanters. The first *Quadrigeminus* is called *Pyriformis* Pear-fashioned, because of its shape, and *Iliacus externus* from its Situation; the rest want names, save the fourth, which is called *Quadratus*.

The *Obturatores* stoppers, take up the wide hole between the Os pubis and Os Ischij. And they are external or internal, the former arising from the outer Circle of the hole of the share: the latter from the inner and they are inserted into the great Trochanter: the inner may be termed *Bursalis* or purse-fashioned because it hides the fourfold tendons in a fleshy purse as it were, neatly shaped by the third and fourth quadrigeminal Muscles.

Chap. 12. Of the Muscles of the Legg.

The Leg is bent by the four muscoli postici.

One of them has two Heads, termed *Biceps*, the first from the joyning of the Os pubis, the second

from the outer part of the thigh, and both of them are inserted with one tendon, the fleshy substance being first increased in the middle, into the hinder part of the Leg.

The second called *Seminembraneus* arises from the swelling of the Ilium, and is inserted into the inner side of the Leg, backwards.

The third is the *Seminervosus*, and has the same beginning and the same end with the former, save that in the hinder parts it is carried little forward obliquely, before it terminates at the inside of the Leg.

The fourth is the *Gracilis*, which is inserted into the same place, and arises from the joyning of the share-bone.

Four Muscles extend the Leg.

The first is the *Rectus*, arising with an acute tendon from the outer and lower Spine of the Ilium.

The second and third are the two *Vasti*, the *external* arising from the whole root, the great Trochanters, and the bone of the Thigh which lies under: the *Inner* from the small Trochanter: they are terminated on each hand at the side of the *Rectus*.

The fourth is the *Crureus*, fixed to the Thigh bone, as the *Brachialis* is to the *Brachium*.

These four Muscles, are terminated into one tendon, which embracing the substance of the flesh into it self, it is inserted before into the beginning of the Leg, and is there instead of a Ligament for it.

Two Muscles, pull it to, inwards.

The first is the *longus, fascialis* or *sartorius* which *Spigelius* and *Veslingus* reckon among the benders, or which Tailors or Borchers rest themselves when they sit cross-leg'd. It is well nigh the longest of all muscles, arising from the former Spina of Os Ilii, and descending obliquely unto the inner and fore-part of the Leg.

The other is the *Popliteus* arising from the lower and outer extuberancy of the Thigh, and being inserted four-square into the inner and upper part of the leg obliquely.

The *Abductor* is one, which is called *Membranosus* and *fascia lata*.

It arises fleshy from the Spina of Os Ilii, and is carried obliquely, into the outer part of the Leg, and with its most broad and long tendon, invests well-near all the Muscles of the Thigh.

Chap. 13. Of the Muscles of the Feet.

The Foot is bended and extended. Two muscles bend it forwards.

The first is termed *tibialis anticus*, affixed to the Leg arising from the upper process thereof, it is inserted into the Os Pedij, before the great Toe, with a tendon which at the end is divided into two.

The other is *Peroneus biceps*, which others count for two muscles, one head arising from the upper Epiphisis of the Fibula, the other from the middle of the Perone. It has a double tendon the lesser carried into the bone of the little toe; and the greater going obliquely under the sole of the Foot, is inserted into the Os pedij just against the great toe.

It is extended backwards by the four *Postici*, *duo gemelli*, the internal and the external, called *Gastrocnemij*, because they constitute the ankle, and arise from the inner and outer head of the thigh under the Ham. The third being call'd *soleus* is added to these beneath, arising

arising from the hindermore appendix of the fibula. These three muscles are terminated into a most thick and strong tendon, to be inserted into the beginning of the Heel and Pterna, by which beasts being killed, are usually hung up. *Hypocrates* did term it *chorda*: where by reason of the fracture of the Heel, he says that hiccups and convulsive feavers do follow.

The last is called *plantaris* and answers to the *palmaris* in the hand; it is lean and meagre, and degenerates into a long tendon, and covering the whole sole of the foot, it arises from the outward head of the Thigh bone, under the Ham: and is inserted into the five toes, and has the same use here which it has in the Hand: though the comparison of one to the other holds not out very exact. *Veslingus* has observed that this muscle has sometimes been wanting.

The *Tibialis posticus* must be added to these, which *Spigelius* reckons amongst the oblique movers, and *Riolanus* among the extensors.

Chap. 14. Of the Muscles of the Toes.

THe Toes of the foot are moved by muscles, as well as the fingers of the hand.

Two muscles bend the Toes, the *Magnus* which answers to the profundus, arising from the upper Epiphisis of the Tibia, under the sole is divided into four tendons, which boring through the minor, they are implanted into the third Articulation of the four toes. The *Minor* answering to the sublimis, is the midst of the sole of the foot, arising from the lower part of the pterna or heel bone, it is carried into the second articulation of the four toes, to which before it comes it is bored thorough, that it may transmit the tendons of the foremost Muscle: and therefore this is called perforatus, the other perforans.

One muscle extends the four toes of the foot, which is by some divided into two; arising from the upper and outer part of the tibia, and having four tendons, which are inserted into the second and third Interjuncture.

The four wormfashioned Muscles do draw them to, answering to those in the Hand, some flesh being intersprinkled from the Heel: They are fastned by so many tendons to the first interjoynting.

The ten *Interossei* do draw them away, arising from the bones of the pedium, and falling the void spaces of

the Metapedium, they are external or internal, the former with a broad tendon do arise by the sides, to the first interjoynting of the toes by the sides; the latter at the second interjoynting: but the ninth serves for the drawing-to of the great Toe, the tenth for the drawing to of the little toe.

The great Toe has peculiar muscles.

It is bent by one only, proceeding from the upper part of the fibula, and inserted into the third interjoynting (*Riolanus* says the first) of the great toe.

It is extended by another, arising from the middle of the Fibula (or as some say from the outside of the tibia, where it recedes from the Fibula) which is oftentimes divided into two tendons.

It is brought to, with one, inwardly fastned to the greatest bone of the pedium.

It is drawn away by one arising fleshy from the inner part of the heel, and entering extrinsically into the first bone of the great toe.

Now there is a new muscle found out above the Interosseans, the first Inventor whereof is *Casseri*; who calls it *transversalis*, because of its situation. *Veslingus* call it the *Adductor pollicis minor*, which use nature seems to have intended.

It arises nervous and broad, from the ligament of the first interjuncture of the little Toe, and sometime from one of the toes next the little toe; and by and by becoming fleshy and so continuing, it is carried athwart over the first joints of the fingers, and with a short and broad tendon, it is implanted into the first joynt of the Great-toe, a little inwards.

The Use hereof is, to secure our walking, when we pass through rough wayes, full of round flints, or over any other small, slippery, or rowling passage. For by help of this muscle, the foot does accommodate it self, to the figure of the Bodies we tread on, and layes hold thereon as it were, that it might make its passage more stead-fast.

The *Abductor* of the little toe, sticking in the outside of the foot broad and vast, arising from the same part of the heel, is inserted into the outside of the first Interjuncture.

I have observed a peculiar bender of the little toe; long, round, arising from the head of the Tibia, and divided with two tendons about the insertion of the toe.

Finally a fleshy mass is to be observed in the sole of the foot, as well as in the Palm of the hand, wherewith our footing is fastened as with a cushion, and the tendons of the muscles do lie hidden, in a soft Pillow.

THE
FIRST MANUAL
 Concerning the Veins,
 Answering to the
FIRST BOOK
 OF THE
Lower Belly.

BOVE, in the Proem of this Anatomical work, I promised *four Books, and four little Books or Manuals*. Four Books touching the three Cavities and the Limbs; Four Manuals, viz. touching the *Veins, Arteries, Nerves and Bones*. Now every Manual answers to its Book. Because from the lower Cavity, namely, the principal part thereof, the *Liver* arise the *Veins*; from the Heart in the middle Cavity the *Arteries*; from the Marrow in the third Cavity the *Nerves*, and to the Limbs the *Bones* do answer. And even as the *Bones* joyned together do make a peculiar *Fabric* or *Skeleton*, representing the form of the whole Animal; so also do the *Veins, Arteries and Nerves*. And *Gulielmus Fabricius Hildanus* a Famous Chyrurgeon hath such a Frame of all the *Veins* of the Body artificially separated; and at *Padua* by the Instruction of *Ad. Spiegelius*, and *John Veslingius*, and *John Leonicemus* such Frames of the *Veins Arteries and Nerves* separated from the body, are commonly to be seen at *Padua*; and the like is to be seen here at *Hafnia* accurately made, and explained in four very great Tables, in the Custody of the renowned *D. D. Henricus Fuirer* my Cofin Germane.

The *Veins, Arteries and Nerves* are Organs or common vessels of the Body, through which some spirit, with or without Blood, is carried from some principal member, into sundry parts of the Body.

Chap. 1. Of a Vein in General.

What a Vein is? A Vein is a common Organ, round, long, hollow like a channel or Conduit pipe, fit to carry or bring back Blood and Natural Spirit.

The term *Vein* was by the Ancients given both to Veins and Arteries; but they call'd the Arteries pulsing Veins, and the Veins not pulsing Veins. and some called Vein, the greater Vein, and an Artery the lesser Vein and the *Aorta*.

The Efficiens of a Vein, is the proper vein-making power or faculty.

The Matter according to *Hippocrates* is a clammy and cold portion of the Seed. And this is the principle of a Veins Original.

But the Principle of Dispensation from whence the Veins arise, is the *Liver* (not to speak of some ancient triflers, who would derive the Veins from the Brain) and not the Heart, as *Aristotle* would have it. For,

'Tis proved against Aristotle that the Liver, not the Heart is the Original of the Veins.

1. Blood is made in the Liver. And therefore 'tis like the original and rise of the Veins is there. and that the first sanguification is not made in the Heart is apparent, because there are no passages to convey the Chylus to the Heart; again there are no receptacles for the Excrements of the first concoction placed by the Heart. But all these requisites are found in the Liver.

2. Blood is carried from the Liver to the Heart, but not from the Heart immediately to the Liver. For Blood cannot go out of the Heart into the Liver, because of the Valves; though mediately when it runs back out of the Arteries, it may be carried thither.

3. Fishes have no right Ventricle in their Hearts, in which they would have Blood to be made; and out of which they would have the Veins to arise, and the Fishes have both Veins and Blood.

4. The *Vena porta* touches not the Heart but the Liver, which the *Cava* also touches: which two Veins are the greatest in the whole body. But according to

flow all Veins ought to be continued with the Heart. You will say; the *Vena arteriosa* does not touch the Liver. I answer, neither ought it so to do: Because it hath the substance of an Artery, and therefore arises from the Heart. But *Arteria Venosa*, is a Vein in substance and use, and in the Child in the womb, was continued with the *Cava*.

5. In the Child in the womb, the Navil-vein with Blood goes into the Liver, not into the Heart.

6. If the Veins should arise from the Heart, they would pulse as the Arteries do; for the whole Heart pulses.

7. Sanguification is never hurt, but when the Liver is hurt, as in a Dropsie, &c.

These are the chief reasons for this Opinion: but many other reasons of other men against Aristotle I reject as weak and easily refuted, as also many weak reasons of the Peripateticks, against this Opinion which we assert, which any one may easily answer, if he be at least but lightly skilled in Anatomy.

The End and Use of a Vein is,
I. According to the Opinion of the Ancients, to carry Blood and Natural Spirit with the Natural faculty, from the Liver into all parts of the Body to nourish the same.

But Nature hath revealed otherwise to their Posterity: for neither do the Veins carry any thing from the Liver to nourish the parts with, nor is the Venal Blood useful for nutrition. But they bring back all the Blood, only to the Heart by Circulation, either mediately by the Liver, as the Mesaraick Veins, or immediately, as the *Cava*; and that either from the whole body, from the smallest branches to the greatest, by the upper and lower branch; or from the Liver whether it be there generated, or is derived from the Mesaraicks and Arteries.

And that they bring the Blood to the Heart as to the Centre, and that they bring it from the smallest parts as from the Circumference, is evidently provided by ocular Inspection, Experiments, and Reason.

I. In Blood-letting, the Arm being bound above the Elbow, beyond the Ligature, the Vein swells not; nor if you should open a Vein would the Blood flow out (which is to be observed in opposition to the Authority of *Scrabonius Largus*) unless very little, or if there were some Anatomosis of a Vein, with an Artery in some parts above. But on this side the Ligature under the Elbow, both the Veins of the Arm swell, and being opened they void as much Blood as you wil, yea all that is in the body. Likewise if with your finger you press the Vein below the Orifice, the blood stops, if you take away your finger it runs again: whence we gather that the blood runs from the outmost small Veins of the body upwards unto the great Veins and the Heart; and not from the upper and greater Veins into the lower, smaller, and more remote.

2. Without Blood-letting, the Veins being pressed with the finger shew as much: for if in an Arm either hot, or whose Veins naturally swell, you force the blood downwards with your finger towards the fingers, there follows no blood in the upper part of the Vein, but it appears empty. Contrariwise, if you force the blood from the Fingers-ward upwards, you shall presently feel the Veins full, more blood following that which you forced up.

3. If you shall plunge your Arms and Legs into cold Water or Snow, being first bound, when you unbind the same, you shall perceive your Heart offended and made cold, by the cold blood ascending thereunto; and it will be warmed if you put your Legs or Arms as aforesaid into hot water. Nor is it any other way by which cordiall Epithems applied to the Wrists and Privities do good.

4. In persons that are hanged, their Heads and Faces become red, the Veins being distended, because the recourse of the Blood into the Heart is hindered: as in opening of the Veins of the Head, the upper parts in the Head swell, the other parts towards the Heart being empty. But the Halter being loosed from the dead body, the swelling and redness of the Face does fall by little and little, unless the Blood which is forced into the smallest Veins cannot run back again because of the coldness of the parts.

5. In Dissections of Live Animals, the matter is most evident. For in what part of the body soever you bind a Vein, it appears lank and empty on that side of the Ligature next the Heart, and on the other side it swells where it is furthest from the Heart, and nearest the extrem parts of the Body.

6. In a living Anatomy, if you lift up a Vein and open it being tied, beyond the Ligature, plenty of Blood flows out, on this side nothing at all, which you shall find true in the crural and jugular Veins of any Creature whatsoever, though you cut the Veins quite in sunder, as I have often experimented with the great *Waleus*, and *Harvey* was not ignorant thereof.

7. The Valves of the Veins do conspire to this end, which are so contrived, that they stand all wide open towards the Heart, and afford an easie passage from the smallest Veins to the greatest, and from thence to the Heart. But from the Heart and great Veins, being shut they suffer nothing to go back, no not Water driven by force, or a Probe, unless being hurt they gape.

8. The Liver sends only to the Heart; the Heart only to the Lungs, and all the Arteries; as hath been already demonstrated concerning the Heart. Seeing therefore the Blood by continual pulsation is sent in so great quantity in all parts, and yet cannot be repaired by Diet, nor can return back to the Heart by reason of the Miter-fashioned Valves of the *Aorta*, nor abide still in the Arteries which are continually giving the same, nor finally is there so much spent by the parts to be nourished; it follows, that what remains over and above is brought back again to the heart, and enters the Veins by Circulation. Whereof although some dark Footsteps are extant in the writings of the Ancients, as I have proved in my Book de *Lucis Animalium*, and *Waleus* and *Riolanus* do afterward declare the same at large; yet it hath been more clearly manifested in this Age of ours to that most ingenious Venetian *Paul Sarpas Fulgentius* as relates from his papers, and soon after to *Harvey* an Englishman, to whom the commendations and praise of first publishing the same to the World and proving it by many Arguments and Experiments, are justly due, finally to *Waleus* and others approving the same.

The Primary End therefore of the Veins is to carry and recarry Blood unto the Heart the secondary ends may be these following.

II. A little to prepare the said Blood, as do the *Rami Lactei*, or to finish and perfect the same, as a final portion of *Vena Cava* between the Liver and the Heart. Their secondary Use.

III. To preserve the Blood, as the proper place preserves that which is placed therein, as much as may be in a speedy passage, and to retain it within its bounds. For extravasated Blood, or Blood out of its natural place, viz. Veins and Arteries, curdles and putrefies. Also in the Veins themselves, when they are ill affected, and the course of the Blood is stopped, sometimes the Blood is found congealed, witness *Fernelius*: sometimes a fatty substance is found instead of Blood, as in the Nerves, which *Bomius* saw among the Indians.

IV. Some would have the red veins to make Blood, and the milkie veins to make Chyle, but they are quite mistaken.

The Form of the Veins is taken from sundry Accidents.

Figure. Its *Figure* is that of a Conduit pipe.

Magnitude. Its *Magnitude* varies. For the Veins are great in the Livet, as in their Original; in the Lungs because they are hot, soft, and in perpetual motion, and therefore they need much nourishment, because much of their substance spends; but especially because all the Blood in the Body passes this way, out of the right into the left Ventricle of the Heart, as hath been proved already. In the Heart by reason of its heat, and because it is to furnish the whole Body with Arterial Blood, received in and sent out by continual pulsings. Also the emulgent Veins are great, by reason of plenty of blood and serosities, which is brought back from the Kidnies to the *Vena Cava*. But where the substance of a part is lasting, and is not easily dissipated, by reason of the small quantity of Heat, the Veins are lesser as in the Brain, where the Veins do not always easily appear, and in the Bones, where they never manifestly appear, though the Animal be great.

In all parts towards the ends they are very small, and are divided into Capillary Veins, sprinkled into, & commonly confounded with the flesh, that the superfluous Blood may be better received into them; which is one way, by which the Arterial Blood is mediately passed through the porous flesh to the Veins, which way also Blood made of Chyle in the Liver, is infused into the little branches of the *Vena Cava*. The other is, by the Arteries immediately. For,

Connexion. The Connexion is such with the Arteries, that every Vein is for the most part attended with an Artery, over which it lies and which it touches. *Galen* tells us a Vein is seldom found without Arteries; but no Artery is ever found without a Vein.

Anastomosis of Veins and Arteries. But there is in the Body a mutual Anastomosis of Veins and Arteries: that they may conspire together, and the Veins receive out of the Arteries Spirit & Blood; which is apparent from reason,

because, 1. If the Veins be quite emptied, the Arteries are empty also. Moreover out of a Vein opened in the Arm or Hand, all the Blood in the Body may be let out, which, because it cannot be contained or generated in the Hand, it must necessarily come out of the Arteries beneath and round about, by means of the Anastomoses: whereof this also is a token, that if the Vein and Artery of the Arm be tied very hard, the Blood ceases running and the pulse stops it beating, til the band be slackned. 2. They are necessary in respect of the Circular motion of the blood, seeing the pores of the Flesh are not sufficient, save in a slow course, and subtile Blood.

Moreover they may be demonstrated in many places to the Eye-sight, where the Conjunctions of the Veins with the Arteries are visible, viz. in the Brain, in the *Plexus Chorioides*, the Cavities, in the Lungs of the *Vena Arteriosa*, and the *Arteria Venosa*, with the Branches of the *Astera Arteria* or Wefand. Of the Thoracick branches descending, with the intercostal Veins. Also the Hypogastrick Veins and Arteries, with the Mammary vessels are joyned mouth to mouth under the *Musculi Rasti* in the Abdomen. But the Anastomoses or mutual conjunction of the mouths of the *Cava* and *Porta* in the Liver, and of the Veins and Arteries in the Spleen, are in a special manner manifest; so in the Veins of the Womb, the seminary vessels, the Navil-strings, and the extremities of the Hands and Feet.

Though the Anastomoses or conjunctions of vessels, are in reason necessary, and manifest to the Eye-sight, yet are they not all manifestly discernable by the Sight. I made experiment in the Liver of an Ox and of a Man, diligently separating all the substance from the vessels; yet could I not either with a Probe, or a Knife, or a pair of Bellows find the Anastomoses of *Vena Cava* and *Vena Porta* open, but all blind, in dead bodies, though it is not to be doubted, but that they are open in living bodies, where all the passages are enlarged by Heat.

Anastomosis of the Veins in the Liver.

This TABLE presents the Anastomoses of Vena Cava and Porta in the Liver,

TABLE I

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The Explication of the FIGURE.

- A The descending Trunk of Vena Cava and Porta in the Liver.
- BE The Vena porta.
- C The Gall-Badder.
- ddddd The greater branches of Vena Cava Disseminated through the Liver.
- eee The branches of Vena Porta.
- ffff The first Parallel Anastomosis of the Vena Cava with the Vena Porta.
- gg The second Anastomosis of Trunk with Trunk.
- hh The third cross Anastomosis.
- ii The fourth Anastomosis mixt.
- kk The fifth Anastomosis, which is oblique or angular.



Of sundry kinds.

I found them to be of divers kinds. The first *Parallel* when the utmost twigs are joyned one to another in right lines. The second is of Trunk with Trunk, a transverse vessel going between. The third is *cross-fashion'd*, when either the Branches go over the Trunk, or the Trunk go over the Branches cross-wise, or the Branches over the Branches in the same manner. The fourth is mixt of the Cross-fashion'd and the oblique. The fifth is oblique or angular, when the Branches are mutually inserted obliquely. I have before explained the *Anastomoses* of the Navil-vessels. Now the *Anastomoses* between the Veins and Arteries, are either in the Trunks or the Capillary Vessels.

Why the Veins are in some places invested with Coats, in others not.

The Veins are sometimes invested with a common Membrane, or some external thick one, borrowed from the Neighboring parts, when either they are suspended and carried a long way, and are without the Bowels and Muscles; or when they rest upon hard bodies. This happens in the lowest Belly, to the Veins and Arteries from the *Peritonæum*, and in the Chest from the *Pleura*.

But where a Vein is inserted either into some Bowell or a Muscle, it needs not this common coat, because 1. It is otherwise sufficiently sustained. 2. Otherwise the ready sweating through of the blood would be hindered. 3. And the laying down of the Excrements of the Vein. 4. It would not so soon be sensible of the force of the substance of any Bowell. 5. It would more hardly imbibe the Blood which is superfluous after the nourishment of the parts.

Now the Veins being so compassed with Membranes do not feel (unless they have Nerves near them) of themselves and by their own Nature, neither the acrimony of the Humors contained, nor cutting or burning. And therefore *Aristotle* saies in his third Book de *Historia Animalium* chap. 5. A Nerve cannot endure the Fire, but a Vein can. And *Galen* in his sixth de *usu partium* chap. 12. saies that if Veins and Arteries be cut, burnt, or tied, they feel it not at all.

CHAP. II.

Of the Substance of the Veins and of the Valves.

The Substance of the Veins is Membranous, that they may more easily stretch and shrink in again.

They have only one Coat, which is proper to them (the Arteries have two) being thin and rare; because through it the blood is to be received after the parts are nourished. it carries not back such stirring and hot blood as the Arteries carry; because it is grown cold and returns quietly to the Heart without any beating of the Pulse that it may be there again perfected.

Whether the Veins have Fibres.

Some conceive that a Vein is interwoven with a triple kind of Fibres: but they ad, that those fibres are there obscurely, and only potentially, nor can be moved out of their place, by reason of the most strait contexture. But I rather conceive with *Vesalius*, that others imagin Fibres to be there, which are no more there than in Leather. for when we pull the substance of the Veins all in pieces, no fibres are there to be seen. But some Authors attribute fibres to the Veins, because they have præconceived this opinion, that Attraction, Expulsion and Retention are performed by sundry sorts of fibres, whenas the fibres if they have any are to strengthen them.

Harvey and Whewell do suspect that the Blood in the

Veins is driven to the Heart, by the fibres, which nevertheless I conceive to be done, by the motion and contraction of the Muscles, with which the Veins are mingled, they not resisting. Yea, and it may be driven by the blood continually following from the parts and Arteries moved by the Pulse. But others alleadge attraction to be made by heat, without the fibres.

Within the Veins are found certain Valves or little folding Cases, which *Bauhine* saies are mentioned by *Avicenna*, under the name of Cells. *Aquapendens* saies himself was the finder of them in the year 1574. to whom *Paulus Servius* or *Sarpi* the *Venician* gave the first hint though it seems apparent by his *Isagogæ*, that *Jacobus Silvius* had also some knowledge of them. But after him or with him mention was made of these Valves by *Salomon Albertus*, *Michaelangelus Pichallominus*, and *Cassperus Bauhinus*; *Laurentius* doth hardly once speak of them.

The occasion of *Aquapendens* finding of them was this: he observed that if he prest the Veins, or by rubbing endeavored to force the Blood downwards, its course did seem to be stopped. Also in the Arms of persons bound to be let Blood, certain knots apper to swell by reason of the Valves; and in some persons, as Porters and Plough-men, they are seen to swell in their Thighs like the Varices.

And here seems to consist the Cause of the Varices; because thick Blood and by its heaviness unapt to move upwards, being long retained in the Valves, makes a dilatation of the said Valves: for without the Valves the Veins would swell uniformly and all of an equal Bigness, and not in the manner of Varices.

And because this Doctrine of the Valves in the Veins, is known to few, I shall propound the same more exactly, according to my manner of handling rare subjects.

These Valves are most, thin little Membranes (thicker in the Orifices of the Veins of the Heart) in the inner Cavity of the Veins; and certain particles as it were of the coat of the Veins; because there the body of the Veins is most thin, where these Membranes do go from it.

They are seated in the Cavity of the Veins, but especially in the Veins of the Limbs, viz. of the Arms and Legs, after the Kernels of the Arm-pits and Groyns. Beginning presently after the rise of the Branches, not in the Rises themselves. Now there are two found in the inner orifice of the jugular Vein, looking from above downwards; the rest look from below upwards, as many in the *Cephalica*, the *Basilica*, and in the Veins of the Legs and Thighs.

No Valves are found in the Trunk of Cava, because the Valves placed in the Divarications do sufficiently hinder the regrefs of the Blood, nor doth the Trunk make any delay. nor are there any in the Jugulars (besides those aforesaid in the Orifice of the inner Veins) because the venal Blood of it self heavy, doth hardly ascend upwards, nor doth it there need any stop. In like manner there are none in the external small Veins; because in regard of their smallness, they needed none, nor is there any danger of the Bloods regrefs, by reason of the nearness of the parts and Arteries which drives the same. We also with *Harvey* have found Valves in the emulgents, and in the Branches of the Mesentery, looking towards the *Vena cava* and *Porta*. Nature endeavored the same in the Milk-veins; also Dogs and Oxen have them in the division of the crural Veins. Also there are none in the Arteries, because in them there alwaies is and ought to be a Flux

Who first observed the Valves in the Veins.

How the Valves of the Veins were found.

The Cause of the Varices.

The Valves of the Veins what?

Where they are not found as the original of the Veins?

Why Valves are not found in the Trunk of Cava, the jugulars, the external small Veins, nor in the Arteries?

The FIGURE Explained.

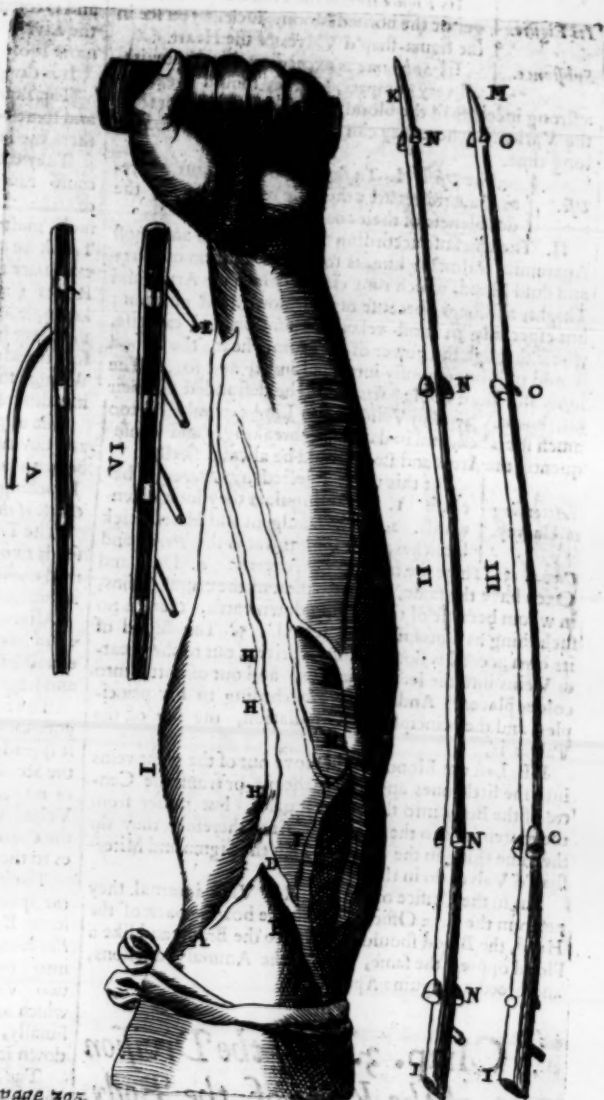
TABLE II

This TABLE in Fig. 1. shews the Valves of the Veins in a bound Arm, in Fig. 2. and 3. The crural Veins the inside outward, with their Valves.

- A. A Branch of the *Vena Cephalica*.
 BF. A part of the *Vena Basilica*.
 D. The *Vena Mediana*.
 E. A Branch of *Vena Cephalica*, to which the *Mediana* was joyned.
 HHHH. Represents the knots in the Veins caused by the Valves there placed.
 IK. One Crural Vein.
 LM. The other Crural vein.
 NNNN. The valves of the Veins fill'd with Cotton-wool.
 OOO. The said valves of the Veins empty.

FIG. V. Shews the single valves of the *Vena Basilica* looking upwards.

FIG. VI. In the Crural vein opened double valves are seen.



a Flux of spirituous Blood, which begins successively and ends with the Systole and Diastole of the whole Body; nor is there any thing to urge a Reflux; moreover the Arteries are of themselves sufficiently strong. Yet I have sometimes observed the footsteps of a Valve in the Artery of the Arm, and it may be to stay the Blood running in the Arteries in that subject, that it may not return, as we see in the beginning of the *Aorta*, and the *Vena Arteriosa*.

Now the Valves are so situate, that they have their Orifices upwards towards the roots of the Veins, and are shut beneath, and alwaies look towards the Heart. And the workmanship of Nature is remarkable in their situation, in that they have their postures looking the same way one following another, as knots in the Branches and Stalks of Plants. that is to say, they are not in a right line one against another, or placed on the same side, least the whole Blood should flow streight in through the free part of the vessel. So the lower Valves do stop, what the upper have let slip: and if all the doors of the Valves had been disposed in one right line, there had been little or no delay made in the regrefs.

Moreover they are situate at Distances, according to the length of the vessel, sometimes two, three, four, or five fingers distance; that if the Blood by some default should be compelled to flow backwards, and should pass the upper Valves, falling on upon the other Valves following, it might be stopped and hindered.

As to their Magnitude they are greater where by reason of the plenty of Blood the Recourse is most vehement, and therefore greater inconvenience was to be feared to happen, either to the parts which would be too much oppressed, or to the Heart least it should be destitute of Blood; as we see in the *Basilica* and in the Crural Vein at the Groyns.

In what Persons there are most Valves.

The Number of all the Valves varies, as also their distances; for there are more Valves in those

1. Who abound with melancholly Blood, or contrarily with very choleric and thin Blood; because both those humors do not only easily resist the Driver, but when they are driven, by their weight and tenacity, they easily flow back.

2. In great or more fleshy Bodies and consequently having more Veins.

3. In such as have the broadest vessels.

4. In such who have long and streight Veins; for in such as are oblique, the crookedness of the vessels gives some stop to the running back of the Blood.

Moreover, the number of Valves in one and the same place doth not exceed two. For they are seated at distances, sometimes one, otherwhiles two at most; not as any time three, as we find in the Vessels of the Heart: because in the Heart a greater orifice is to be shut, and the Ventricle underneath is larger, yea and the greater violence of the Blood in the hot Heart, did require more stops. But in the progress of the Veins, their Branching diminishes their Magnitude, and the blood is slower in motion

motion. Therefore where the Veins are yet pretty big, and there is danger from the plenty of Blood, there are two doors, but otherwise but only one.

Its Figure. Its Figure likens the Nail on a Mans finger or the horned Moon, such as you see in the sigma-shap'd Valves of the Heart.

Substance. Its Substance is exceeding thin, but with all very compact, lest they should break by a strong incourse of the blood. And this is apparent from the Varices, where they can contain the blood a very long time.

Use. The Use is I. To strengthen the Veins, where as the Arteries are otherwise made strong by the doubleness of their coats.

II. The chief use according to *Aquapendens* and most Anatomists following him, is to stop the motion of heavy and fluid Blood, which runs violently into the Arms and Thighs, and Legs, because of their downward position; but especially in most vehement motion and exercise, where through the power of exceeding heat, the Blood would rush impetuously into the Limbs, and so 1. The inner and more noble parts would be defrauded of their nutriment. 2. The Veins of the Limbs would be too much stretched, and in danger of breaking, and consequently the Arms and Legs would be always swelled.

But this use is rejected by *Harvey*, because 1. In the Jugulars they look downwards. 2. In the emulgent and Mesenterick branches, they look towards the *Porta* and

Cava. 3. There are none in the Arteries. 4. Dogs and Oxen have the same, in the division of the crural Veins, in whom because of their going downwards, there is no such thing as aforesaid to be feared. 5. The Blood of its own accord is slowly enough driven, out of the greater Veins into the lesser Branches, and out of hotter into colder places. And therefore according to his principles, and the principles of Circulation, the use of the Valves is,

III. Left the Blood should move out of the great veins into the little ones and so rear them; or from the Centre of the Body into the outmost parts, but rather from the extremities to the Centre. And therefore they do the same thing in the Veins, which the Sigma and Miter-shap'd Valves do in the Heart.

But in the Orifice of the Jugular Vein internal they perform the same Office, least in the bowing back of the Head, the Blood should return into the Brain, and like a Flood oppress the same, disturb the Animal Functions, and breed a sanguine Apoplexy.

Chap. 3. Of the Division of the Veins of the Body, and of the Vena Porta and the Venæ Lactææ.

ALL the Veins of the whole Body are referred unto two as their Mothers; viz. the *Vena Porta* and the *Vena Cava*, to which is joyned a third kind of vessels found out by *Asellius* viz. the Milky Veins, of which we shall speak by and by.

The *Vena Porta* its Original and Root is the *Vena Umbilicalis*, of which I spake in the first Book, the first of all the Veins, arising from the Seed.

Now it is termed *Vena Porta*, or *Que ad Portas est*, the Gate-vein, and Vein at the Gates, and *Vena osiaria*, the Door-vein; because through the roots thereof, or, as others will have it, its branches, viz. the Mesaraick Veins, the Chyle being suckt out of the Stomach and Guts

was anciently thought to be carried, as it we.e by Gates into the Liver. The Arabians call'd it *Vena Lactea*, because they thought it drew the Chyle, white like Milk.

This is the greatest Vein in the Body next the *Cava*, and is commonly said to arise out of the hollow part of the Liver. And it is not so compact as the *Cava*, but more loose and soft.

It is divided into the Trunk and Branches.

The Branches are upper and lower: The Branches of the and some call the former Roots, others the latter. *Porta in the Liver, termed Roots.*

They call the former Roots, because this Vein is said to have its original out of the Liver: the latter, because as Roots suck matter out of the Earth, and carry it into the Trunk of the Tree: even so also the *Vena Mesaraica*, which are the lower branches of *Porta*, do suck Chyle like Roots (according to the Ancients, but according to our late opinion blood out of the Mesentery) and carry it to the Liver by the Trunk and upper Branches; and therefore the Mesaraick Veins are termed the *Livers Hands*. We may therefore call them all, both branches and roots, in a different respect.

The upper Branches, four or five of them are spread up and down the hollow part of the Liver, which afterwards, beneath and without the Liver, grow into one Trunk. Touching these and their Anatomies, see above, in the Chap. of the Liver, Book the 1.

The Trunk before it is divided into lower Branches, sends two small Veins to the Gall-bladder which are termed *Cystica gemella*; another Vein to the Stomach, which is therefore call'd *Gastrica dextra*.

Afterward the Trunk inclining to the left hand, it is divided into two remarkable lower Branches: the one higher and lesser, going towards the left side; the other: lower and larger on the right side.

The former is called *Splenicus*, because it goes into the Spleen, & before it is divided it spreads from it self two upper Branches to the Stomach, the *Gastrica minor* and *Gastrica major*, the largest of all the Stomach Veins, which afterwards constitutes the the *Coronaria*. Then it sends lower branches to the Call and one to the *Pancreas*.

These being thus constituted, the Trunk *Splenicus* is divided, into the upper and lower Branch. The former produces the *Vas breve* and other little branches carried into the Spleen. The latter produces two Veins for the Call and Stomach which are termed *Epiplois sinistra* and *Gastroepiplois sinistra*. Finally, the rest of its final branches, are spent up and down in the Spleen.

The *Rami dexter* of the *Vena porta*, before it is divided, produces two Veins, 1. To the right side of the Stomach and Call. 2. To the Guts, viz. the middle of *Duodenum*, and the beginning of the *Jejunum*: whence certain capillary twigs go through the *Pancreas* and Call upwards.

Afterwards an whole large Branch goes into the Mesentery, and being carried between the two coats thereof, it is distributed into three notable Branches, called *Rami mesenterici*, the Mesenteric branches.

The right-hand mesenteric branch is two-fold, which spends it self into fourteen nameless branches, and these again into innumerable Off-springs of Veins termed the *Mesaraick Veins* in the Guts, *Jejunum*, *Ileon* and *Cecum* and part of *Colon*. The Mesaraick Veins.

Use is, 1. According to the Ancients, to suck the Chylus out of the Guts, and to carry it by the Trunk of *Vena porta* into the Liver. but the milkie Juice of the Chylus is never

The Spleen-Veins of the Stomach.

Call. *Pancreas.*

Splen.

Call.

Stomach.

Of the Stomach. Call. Guts.

Of the Mesentery.

The Mesaraick Veins.

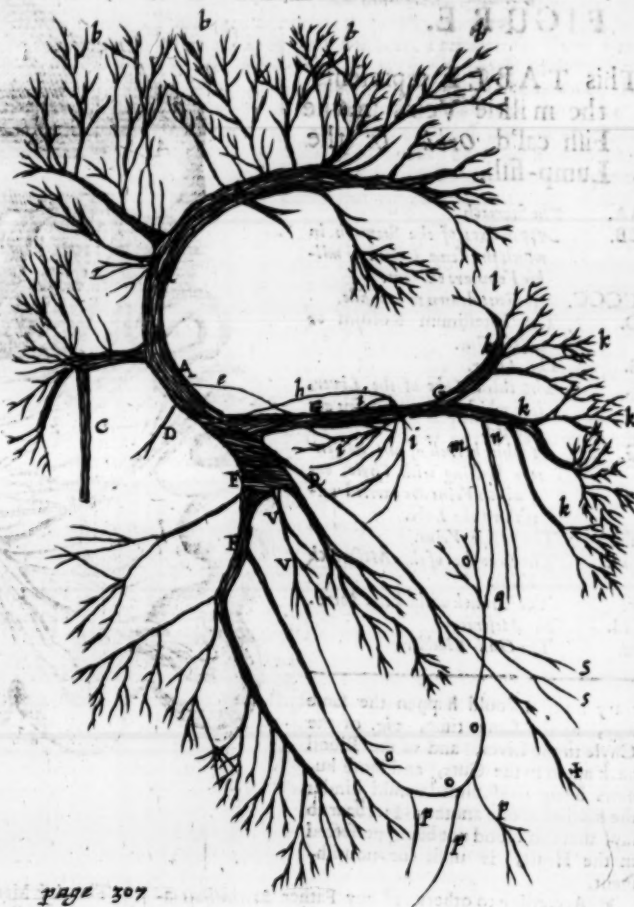
Their Use.

Chylus is never

The FIGURE Explained.

This TABLE shews the Branchings of the *Vena porta* within and without the Liver.

- AAA. The Trunk of the *Vena porta* going out of the Liver.
- bbbbb. Its branchings in the Liver.
- C. The Umbilical or Navil-vein.
- D. The *Vena Cystica*.
- e. The Implantation of the Coronary Vein of the Stomach.
- FF. The right Branch of the *Vena porta*.
- G. The left Splenick Branch thereof.
- h. The Rise of the Coronaria of the Stomach, which after it hath bestowed many branches upon the Stomach is self, being turned back towards the Pylorus, is implanted into the Trunk of the *Vena porta* in self, where the letter e stands.
- iii. Little branches of the *Vena splenica*, distributed through the Pancreas.
- kkkk. The manifold ingress of the said *Vena splenica* into the Spleen.
- L. The *Vas breve* so called.
- m. The *Gastroepiploica sinistra*, which runs out upon the bottom of the Stomach, and affords many branches both to the Stomach in self, and to the Gall.
- n. The *Vena Epiploica sinistra*.
- ooo. Little branches disseminated through the bottom of the Stomach.
- PPP. Branches which run out through the Gall.
- q. Another *Epiploica* superior to the precedent, for it runs before it, through the lower part of the Gall, which comes nearest the Loyns.
- R. The Rise of the internal Hemorrhoidal Vein, which
- SSS. Diffuses Branches through the Mesentery, and as last where this mark stands is sends forth the Hemorrhoid Veins so called.
- V. The *Gastro-epiploica dextra*, from which many branches arise that are disseminated through the Gall and Stomach.



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never found in these, they being alwaies full of Blood. Moreover the finding out of the Milkie Veins is repugnant to this Use. Howbeit in time of necessity when the milkie veins are totally obstructed, *Riglauius* grants that the Chylus is carried by these without any Argument. For they do not open themselves into the Guts, for then blood would be poured into them, and in my judgment, nutrition should rather cease, as we see in the Lientery, when they are obstructed.

According to *Harvey* to refute the milkie veins, and withall to maintain his Circulation in the Mesentery, does suppose that as the Navil-veins draw in alimentary juyce from the Liquors of the Egg, and carry it to nourish and increase the Chick. Even so the Mesaraick Veins do suck Chyle out

of the Guts, and carry it into the Liver, even in a grown person. But then they should carry Chyle and Blood together, and so divers juyces would be jumbled together, such as were digested with those that are indigested. And what need is there to confound Vessels that Nature hath distinguished. And every one knows, that the use of the Navil-vessels, is different in a Child in the womb and a grown person.

2. According to the same Antients, to prepare the said Chyle in some measure, and to give it the rudiments of Blood. which would be true if the Hypothesis were true.

3. According to the said Antients, to carry the Blood back from the Liver, to nourish the Guts. But so a contrary

The Explication of the FIGURE.

This TABLE represents
the milkie Veins in the
Fish call'd *Orbis*, or the
Lump-fish.

- AA. The Stomach.
- BB. Appendixes of the Stomach in
which the *Vena Lactea* or mil-
kie Veins are evident.
- CCCC. The Guts drawn to one side.
- D. The Intestinum Rectum or
Arse Guts.
- E. The Liver.
- F. The third Lobe of the Liver,
into which the milkie veins are
inserted.
- G. A white kernell of the Mesen-
tery swelling with Chyle, one
of which Veins are carried un-
to third the Lobe.
- hhh. The milkie Veins.
- iii. The Branches of the Mesaraick
Veins.
- k. The Trunk of the *Vena porta*.
- lll. The Mesentery.
- m. The Gall-Bladder.



trary motion would happen the same way, at the same time, viz. of the Chyle to the Liver, and of the Blood back again to the Guts, and those humors being confounded would hinder the motion of one another. I forbear to say, that this blood not being perfected in the Heart, is unfit for nourishment.

4. According to others and my Father *Bartholinus* amongst the rest, to carry thick blood made in the Spleen from thence to the Guts to nourish them, which were true did not the Circulation teach otherwise, which hath been found out since his time. And that same blood would be more fit to nourish, by reason of the abundance of Arteries in the Spleen. The Vessels being changed, this Opinion would be absolutely true.

5. *Afellius*, who rightly assigns the milkie veins to carry Chyle to the Liver, hath shewn that these common mesaraick Veins do serve to no other intent, then to bring blood out of the Liver to nourish the Guts, which use, being before refuted, he is therein to be excused, who was likewise ignorant of the true motion of the blood.

6. Their true Use is to bring the Blood back after the nutriment of the Guts, into the Liver, which had bin carried to the Guts, by the mesaraick Arteries. This is apparent by Ligatures in living Creatures, which *Waleus* practised, in which they swell towards the Liver, but are empty towards the Guts. The *Valvæ* shew as much, which were by *Harvey* found out in the mesaraick veins, looking towards the Cava and the *venæ portæ*, which *Columbus* also observed, and which hinder the blood of *vena portæ* from passing into the Guts. Nor does the Conflux of humors out of the Body about the Guts hinder, whether the Humors flow thither of their own accord or provoked by medicaments; because this passage of the Humors is certainly through the mesenterick Arteries which neither *Spigelius* denies, nor those that maintain the Circulation of the Blood.

TABLE IV.

The left Mesenterick branch is spread abroad into the left and middlemost part of the Mesenteric, and part of the Colon from the left side of the Stomach, and to the *Intestinum rectum*. Hence arises the *Vena Hemorrhoidalis interna* so called, of which in the following and proper Chapter.

This Age of ours being clearer sighted then the former, has found out the milkie Veins in the Mesentery so called, from the white colour of the Chyle in them, which besides the Mesaraicks, make a fourth kind of vessels, through which the Chylus is carried into the Liver. *Erasistratus* in *Galen* had a glimpse of these veins, but after him, the first that discovered them was *Caspar Asellius* an Anatomist of *Ticinum*, in the dissection of a living dog well fed, on the twenty third of July in the year 1622. In whose footsteps accurate Anatomists treading, who prized nothing more then truth, have found by testimony of their eyes, that those same vessels full of a milkie juice, are peculiar passages different from the Mesaraicks. For in living Creatures they are allwayes to be seen, if they be dissected about four hours after they have been well fed, viz. when the Chylus is distributed: for after that time they are not to be seen, howbeit, though empty, they always appear like little fibres which have deceived some, making them to take these vessels for nerves: but they are out, because nerves neither have such a Chyle as this, nor Valves nor any cavity. Nor are the Mesentery and Guts so sensible, although they have a few nerves from the first Conjugation

Conjugation. Some have conceived these vessels to be Arteries, but contrary to sense, which acknowledg here a simple coat, and no motion. Only the not knowing of their Trunk, does keep some learned men as yet in suspense, which if it could be demonstrated to be in the Liver, they would be of our mind. But although their Trunk and Original be unknown yet no man should doubt of the existence of these Veins any more then the Inhabitants about *Nile* doubt of the Existency of that River, whose Head is unknown. And others account it no impossible thing, that they may by their twigs be implanted into the Liver without any Trunk. Yea and it seems not improbable to the renowned *Kyperus* and *Regius*, that the milkie veins being confounded with the Mesaraicks in the *Pancreas* or great kernel, do there empty their Chyle into the *Vena Portæ*, and so it is carried by the Veins into the Liver, that it may be mixed with the *Fermentum* brought from the Spleen, and so receive the Rudiments of Blood. But I shal by and by shew that the milkie veins have branches which reach into the Liver, where they are inserted.

But I will briefly relate the History of these milkie veins, following the guidance of *Asellius* and others, and mine own Experience, who have diligently viewed them, in live Animals, and Men newly hanged and choaked.

These vessels are termed *Lactes* or *Lactea* *Vasæ* also *Vena lactea* either from *Lacio* a word out of date, signifying *Allicio*, I draw, or a *lacte* from Milk, which they resemble in whiteness, softness and fatness; even as the Ancients and later Writers have given the same name, to the small Guts, the mesaraick Veins, and the Mesentery, for the same cause, though the agreement and verity be not the like.

They were quite unknown to the Ancients, if you except *Erassistratus*, who in Kids that had lately suckt, saw certain obscure Arteries which were soon filled with milk, yet most Ancients were ignorant, that there were one sort of vessels to carry the Chyle, and others to carry the Blood. But they may be easily excused, by indifferent Censurers, because they commonly dissected Animals that had been strangled, in which bodies, unless they be tied, they suddenly disappear. *Galen* who had made more than six hundred live Anatomies, did without doubt take them for Nerves.

Their Situation. ly, where they are for the most part accompanied with Fat, which cherishes that Heat which is necessary for the attraction and preparation of the Chylus.

They are carried through the *Mesenterium*, from the Guts, by an oblique passage, between its two coats, partly separate from the other vessels, partly together with them, sometimes streight along, otherwhiles going over the same, and cutting them crosswise as it were, through many kernels, placed chiefly at the parting of the branches; they are carried, I say as far as to the *Pancreas*. In the *Pancreas* or great kernel of the Mesentery, which *Asellius* after *Fallopins* calls *Pancreas*, they are wreathed and wrought together like a Lattice, this way and that way, into very many and those inexplicable wreathings and Labyrinths.

From thence again, having sent greater branches by the sides of *Vena portæ*, and sometimes also twigs to the *Vena Cava*, they enter with small Branches into the Cavity of the Liver. From thence, being carried to the Liver it self, and split into very small fibres, they are so long spread up and down into the flesh thereof, every way, til they are at length quite obliterated.

But into what part of the Liver, either the Trunk or Branches are inserted, I have not found by any as yet determined, by reason of the sudden Efflux of

the Humors. I, in the dissection of the fish call'd *Orbis*, by our Country-men *Steenbud*, by *Gesner* Sea-Hare, by *Clusius* the frog-mouth'd *Orbis*, by the *Islanders* *Roe-massue* from the color of its Belly; both Male and Female here at *Hafnia* frequently repeated, in the presence of the most learned *Wormius*, *Sperlingerus*, *Simon Pauli*, *Fuerinus*, and others, have found and demonstrated not only many daies after, great plenty of milkie veins, full of the white milkie humor, but also the true place of their Insertion. which was the third Lobe of the Liver, that same little soft one described by *Spigelius*, into which there entred a milkey branch sufficiently great, from the large kernel seated not far off, and swelling with the milkey humor, unto which kernel, the most of the milky veins out of the *Mesentery*, and the apputenances of the Stomach, had their Course. Nor is it to be doubted, but that the same betides in men and other Creatures Nature so sharing the business, that to each Lobe its Trunk may be assigned. Now from this they go further, with the branches of *Vena portæ*, inwardly to the rest of the Lobes, and their *Parenchyma*. And it is to be observed, that about this third Lobe, where the milkey veins are inserted, the Gall-Bladder is placed, either to assist Concoction which begins there, or to receive the chole- rick Excrement, which in the Concoction of the *Chylus* is separated therefrom.

Now they are inserted into all the Guts, yea even the *Duodenum*, but especially into the smaller Guts, not so many into thick ones, nor are any of them carried to the Stomach or the Spleen. And least the Chylus once received should slip back again into the Guts, they are furnished with Valves which look from within outward, which wil not admit the Chyle though driven back with Violence.

Its Substance is of a Vein, which it resembles in structure and all things else, excepting the milkie juyce. Of which there are three compounding parts, *Fibres*, a *Membrane*, and *Flesh*. They have but one single Membrane, wherein they differ from Arteries, neither are they here clothed with so thick a coat, no more than in other remote parts, though in the Mesentery they receive from it another external coat. *Asellius* doth attribute to them all kinds of fibres, Right, Transverse, Oblique, for Drawing, Retaining, and Expelling; though *Walens* by Ligature do teach, that the Chyle is rather thrust in them to the Liver, by the Guts contracted and driving the same; and others conceive that it is drawn by the Liver it self.

The *Flesh* which grows to the Membrane, fills up the spaces between the fibres, whose use besides is, to prepare the Chyle before it comes to the Liver.

As for Quantity they grow continually one to another, being all of one Trunk though their magnitude be not equal, some being greater others lesser. Now they are small, least the thick and unprofitable parts of the Chyle, should go into them together, and least distribution should be made too suddenly and tumultuously, which *Frambesarius* observes.

They are infinite in Number, dispersed through the Liver, Guts, Mesentery and *Pancreas*, and so much more in number than the vulgar Mesenterick Veins, that their plenty may make amends for their smallness.

As to the first active Qualities, they are colder than ordinary Veins, because the Chyle which they carry is colder than Blood. In respect of the passive qualities, they are dry, yet moister than the common Veins.

In respect of the second Qualities, they are thin and exceeding subtle, where they enter into the body of the Liver; Tender, Smooth, Rare, Rough by reason of the Fibres within them. From these qualities follows their colour which is white, partly because they were made of cold seed, partly because of the white Liquor which they carry, For

The Explication of the FIGURE.

This TABLE Represents the milkie Veins,
or *Vena Lactea*.

- AA. &c. The Mesaraick branches of the *Vena porta*, and the branches of the *Arteria Cœliaca*, which accompany the same.
BB. &c. The *Vena Lactea* or milkie Veins, which being bound in the lower parts do discover the Valves.
CC. The Nerves running up and down through the Mesentery.
D. The Bottom of the Stomach.
E. The Pylorus.
F. The *Gus Duodenum*.
G. The *Gus Jejunum*.
H The *Gus Ileum*.
I. A Vein and Artery creeping through the bottom of the Stomach.
K. Part of the Gall.
L. The great Kernel in the rise of the Mesentery which *Asellius* calls the Pancreas.

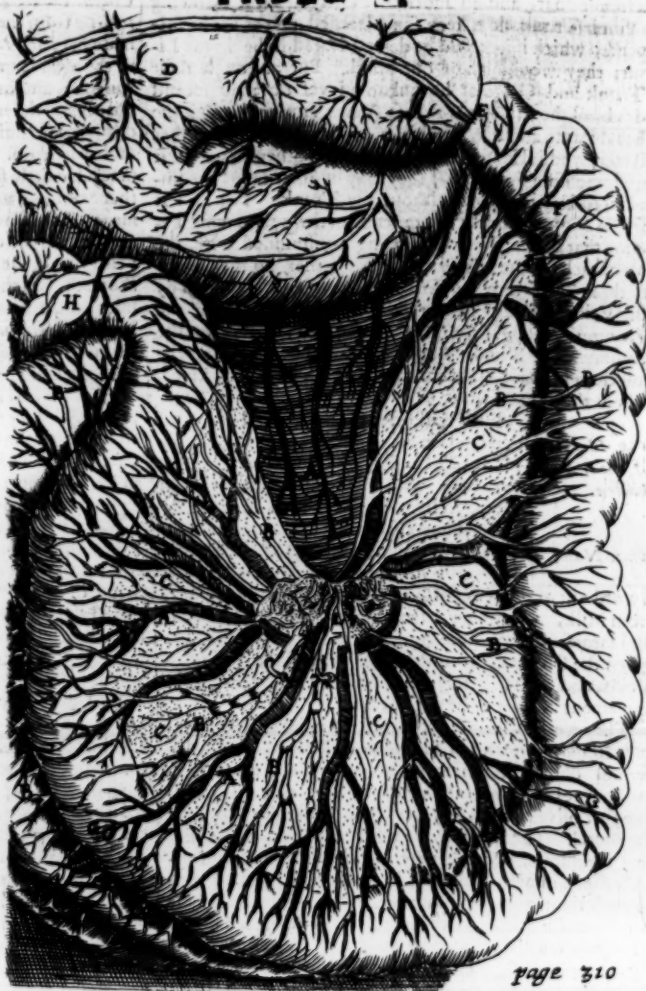
Their Use. | Their Action and proper Use is 1. To deliver up the Chylus to the Liver, not by the Mesaraicks as hath been hitherto believed, by which neither the Chylus ascends to the Liver, nor the blood descends to the Guts, as was said before. Nor let the abundance of the said Mesaraicks trouble us, which the cold and bloodless Guts do not need; because doubtless they need more of Heat and much nourishment, administered by the abundance of mesaraick Arteries, and therefore plenty of Veins ought to answer the plenty of Arteries, that they might carry back the superfluous blood to the Liver.

II To render the Chyle more fit to receive the form of Blood in the Liver. But they are deceived who do assigne to them the blood-making faculty, for the Chylus is not at all changed in colour till it come unto the Liver, where it begins by little and little to grow reddish or paleish.

III They much conduce to facilitate the Art of Physick. For 1 They discover a ready way for distribution of the Chylus, which has hitherto bin very much controverted, without any fear of a contrary motion or confusion. 2 They shew that the Blood is made in the Liver and its flesh, and not in the veins. 3 That the sucking of the Veins is no cause of Hunger, because none are carried to the Stomach.

IV They declare the Causes of some Diseases of the Body which were before obscure, viz. of the chylous flux of the Guts; of pineing away of the Body, for want of Nourishment, by reason of the kernels of the Mesentery overcome with scirrhus swellings, of intermitting Agues quarred in the Mesaraicum, Hypochondriacal Melancholy &c.

TABLE V.



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V The learned *Gassendus* conceives that by the milkie Veins the white juyce contained in them is carried over the whole Body, to breed Fat; and that the true Chylus is brought the neerest way by the Porus biliaris, out of the Stomach unto the Liver; But neither of these may be granted. Not the former, because of the reasons brought before, Book the 7 against *Folius*, touching the matter of Fat which *Riolanus* approves and commends; nor the latter, because the Chyle would be infected by meeting with bitter Choler, though that renowned man allows in case of necessity, the Jejunum being obstructed, it may so be done.

And so much may suffice touching the History so the *Vena Lactea*, to which there is hardly any thing remaining to be added, unless the cause of their sudden disappearing, which is sufficiently controverted, which is not to be imputed to the spiritual disposition of the Chylus which suddenly vanishes away, as *Asellius* did at first beleive, because the Chylus being drawn out of the Veins does keep its colour a very long time, not vanishing away, but becoming waterish. But to that which did afterward seem probable to *Asellius* viz. the strong drawing of the Liver, in so great Anxiety of the Ainalg,

all this

this may be attributed, by which the spirits being consumed, they need new Blood and Chyle speedily to be digested. And hence a reason may be rendered, why the *Vena lactea* in a man hang'd at *Amsterdam* cut up by *Dr. Tulp*, remained visible many daies after; such as have bin divers times seen by *Veslingius* at *Padua*, and *Folius* at *Venice*: For by reason of the pains broke off by choaking, there could be no drawing of the Liver. For whereas in a Girl ten months old, *Veslingius* found these Veins swelling: I ascribe that to a like weakness of the Liver, or the thicknes of the milkie humor. I also saw at *Hafnia* the last yeer, the milkie veins in *Sueno Olai* of *Varberg* (who was immediately choak'd with a peice of neats-tongue, having before eaten and drank plentifully) visible in the Mesentery, because respiration being hindred by the bit of tongue, and his heart being suffocated, there was no necessity for the Liver to draw any Chylus. But *P. Lauremburgius* as a man ignorant of this Anatomy does vainly imagine with himselfe, that these veins do disappear, because of the recourse of the Chylus to the Guts, the Valves being loose and flaggie: for, I Do all you can, you shall never bring the Chylus back, in dead bodies into the Guts. 2 If a vein be tied in the middle, so that a passage is left open on both sides, both towards the Liver and the Guts: where it looks to the Liver it is empty, but it swells exceedingly towards the Guts, and if it be left in that posture for some daies together the Chyle will not slip back into the Guts.

CHAP. IV.

Of the Hemorrhoid Veins.

The Hemorrhoid Veins what?

some men at set times do open of their own accord, and void forth dreggie Blood, which evacuation does much conduce to Health.

The Error of other Anatomists.

These Veins are not of one kind, as the Ancients and many later writers have Imagined: But some are termed *internal*, which arise from the *Vena portæ*, others *external*, from the *Cava*, with which the hemorrhoidal Arteries are associated, through which the Humors to be evacuated, are carried.

The Ancients knew only the *Internal* ones, as being commended in melancholick and spleenetick diseases: and they may be opened about the fundament, or leeches may be applied to them, whereas otherwise no branches of the *Vena portæ* which lies concealed within, do go out to the skin, which can be opened.

The Differences between the internal and external Hemorrhoids.

The internal and external Hemorrhoid Veins differ one from another. I In their *Original*. For the *Internal* arises as was said before, From the *Vena portæ*, and descends along the end of the Colon, under the right gut, the end whereof or Fundament, it circularly embraces with certain final twigs. It arises sometimes from the *Ramus splenicus*, from whence is the *Vas breve*. But seldom which *Casseri* once observed, from the Spleen itself. *Veslingius* observed it twice or thrice, and therefore *Robert Flud* is out, who condemns the opening of the Hemorrhoid Veins, because they void not from the Spleen, but rather from the Mesenterie, to the great damage of the Guts and Stomach.

But the external Hemorrhoides arise from the Hypogastrick branch of the *Cava*.

II By their *Inferion* For the *internal* is inserted into the substance of the *Intellinum rectum*, which is membranous, and required thick Blood made in the Spleen, and communicated by the *Arteria Cœliaca* or *Splenica*.

The external are inserted into the Musculous Substance of the Fundament, which required purer Blood, elaborated in the Heart, and brought hither by the branches of the Arteries.

III In *Number*, the *Internal* is one in number, the *external* is threefold.

IV In the *Quality* of the Blood contained. The Blood of the inner is thick and black, the Blood of the outer is thinner and redder.

V In their *Use* The internal empty the *Vena portæ* successively, but first the Spleenick Arteries, and help the Obstructions of the Spleen: the external empty the *Vena Cava*, the Liver by accident, but primarily the great Arterie, and the Heart; yea their evacuation cures diseases springing from Blood, of the Head, Chest, &c. Which *Hippocrates* hints in his *Aphorismes*, and therefore the internal are said to cure the *Cacoehymia*, or badness of Humors, the external the *Plethoria* or fullness of good Blood.

VI In the plentiful profusion of Blood. The flux of the internal ones is not so plentiful; that of the external is sometimes so large, that men die by the extremity thereof, or fall into greivous diseases.

VII In the Evacuation of the external ones, there is no Paine nor Gripeing of the Belly; and sometimes also no paine in the Fundament; but in the flux of the inner Hemorrhoides, there is greivous paine.

VIII The *Internal* do alone descend, unaccompanied with the Arteries, howbeit either the Arteries are hidden, or they depend of Arteries in the upper-more.

The external descend with the Arteries to the Muscles of the Fundament, manifestly; and therefore the external are more properly called *Vasa Hemorrhoidalia*, to include the Arteries with the Veins.

Chap. V. Of the ascending Trunk of Vena Cava, especially of the Vena sine pari.

VENA CAVA called also *Vena magna* and *maxima*, the great vein and the greatest vein, by the Ancients, because of its exceeding largeness, and by *Aurelianus*, *Vena crassa* the thick Vein, is the largest Vein in our whole Body, and the Mother of all other Veins which do not proceed from the *Vena Portæ*; coming out of the bunching or convex side of the Liver, and therefore by *Hippocrates* termed the Liver vein, having spread many Veins through the upper part of the Liver, which about the top are collected into one Trunk it is presently divided into the upper or ascendent, and the lower and descendent Trunks.

The *Ascendent Trunk* pierces the *Midriff*, is spread about through the Chest, Neck, Head and Arms. Now it is carried undivided, as far as to the Jugulum. Mean while four branches arise there from.

1 *Phrenicus* or the *Midriff vein*, on each side one, whence also branches are sent to the Pericardium and Mediastinum. That Quittor in such as have the *Empyema*, is carried by this Vein to

The Vena Cava what?

Its division into great Trunks.

The ascendent Trunk what?

The Vein of the Midriff pericardium and mediastinum.

the

the Kidnies and Bladder *M. A. Soverinus* ingeniously proves, because 1. The quitor must needs rest at the bottom of the Midriff. 2. By the motion of the Septum it is easily made thin. 3. By the same motion the mouths of the vessels are opened. which may more truly be said of the Arteries, which carry Blood to the Kidnies by their emulgent Branches, and with the Blood sundry excrements, as quitor, Serum &c.

Afterwards the *Vena cava* ascends by the Septum, and boring its passage through the Pericardium, it goes a little towards the left hand, and insinuates it self into the right Ventricle of the Heart, with a large hole, where it is joyned on all sides to the left Ear-let: and there is made, 2. The *Vena Coronaria*, which is sometimes double, compassing the Basis of the Heart, at the Rise whereof a little Valve is placed, not suffering the Blood to return into the Trunk. For it is joyned with a continued passage to the Artery, that it may therefrom receive blood, which is to return to the *Cava*.

Afterwards the ascendent Trunk does at last, bore its way through the Pericardium, and taking the former shape, it had under the Heart, but smaller, thorough the middle division of the Lungs (no more upon the Vertebra's of the Chest, where now the Gullet and Wefand rest) it ascends to the Jugulum. Mean while there is bred

3. A remarkable Vein above the Heart called *Azygos, sine pari*, the Vein without a fellow, because in a Man and a Dog, it is commonly but one, quartering on the one side, without another on the other side. But there are two in some Creatures which chew the cud, as Goats, and in Swine &c. And in the Body of Man I have often seen two, once I found none at all, instead whereof on each side there descended a Branch from the *Vena Subclavia*.

It arises from the hinder part of the *Cava* but more towards the right hand, and descends through the right Cavity of the Chest: but in Sheep contrariwise, it arises from the left side of the *Cava*, and descends through the left. In a Man after its Beginning, which is between the fourth and fift Vertebra of the Chest, it bends a little back towards the right side and outwardly, unto the eighth or ninth Vertebra of the Chest; where it begins to possess the very middle space. Howbeit, I have observed it presently after its rise, to descend right forward, above the middle of the Back-bone, and to send out branches on each side.

This *Truncus sine pari*, for the space of eight lower Ribs, sends out on each hand Intercoastal branches, which are sometimes here and there joyned by way of *Anastomosis*, with the branches of the Thoracica inferior which arises from the Basilica, and with the Intercoastal Arteries. And therefore a Vein is not alwaies to be opened in a Pleurisie of the right side, as *Vesalius* would have it.

Neer the Eighth Rib, it is divided into two Branches.

The one being sometimes the greater, ascends under the Diaphragma to the left side, and is inserted sometimes into the *Cava* above or beneath the Emulgent, sometimes

How pleuritic persons are purged by Urine.

into the Emulgent it self. This way, according to the vulgar Doctrine, pleuritic persons, are many times critically purged by Urine, and void out that way abundance of Quitor: which matter may more truly be said to be purged out by the emulgent Arteries, by mediation of the Heart.

The other on the right hand, goes to the *Cava* and is joyned thereto, seldom to the Emulgent, sometimes above, the Emulgent. Often times it is implanted into the last

It by the Ham-vein is probably opened in a Pleurisie.

sometimes into the first lumbal Vessel; for which cause, in the beginning of a Pleurisie, the Ham-vein may be opened, to draw away the

Blood, which would otherwise ascend out of the Arteries and small Veins, into this Vein.

And whereas *Hallerius* and *Amatus* dream that this Vein hath Valves in its Beginning, it is false, and therefore false it is, that the *Cava* being evacuated, the *Vena sine pari* is not evacuated, because the Regurgitation is hindered by the Valves. *Fallopins* denies them, because he saw both Wind and Blood regurgitate from thence.

The Error of Amatus Lufitanus and Hollerius touching Valves.

4. The *Intercoastalis superior*, on each side one, which is sent to the Intervals of the four upper Ribs, when the *Azygos* hath not sent branches to all the Intervals of the Ribs.

Chap. 6. Of the Vena subclavia and its Branches, and the Jugulars.

THE Branches aforesaid being constituted, the *Cava* ascends to the *Clavicula*, underpropped with the *Thymus*, where it is commonly thought to be divided, and in many Anatomical Tables is so represented, into four parts, on either side into an upper part and a lower. whence a common Error of Practitioners arises who scrupulously open the Basilica Vein, in parts affected beneath the Neck; the Cephalica in Diseases of the Head. But at the *Clavicula* channel-bones the *truncus vena cava* is divided not into four branches but two only, on each side one, the right and left, which are termed *Subclavij* and by some *Axillares*.

The Error of other Anatomists.

An Error of Physicians in Blood-letting.

Wherefore it matters not in Diseases below the Neck, whether you open the Basilica or Cephalick Vein: for the Trunk of *Vena Cava* is alike emptied, for the Cephalica and Basilica proceed from one root. The Chyrurgeon ought to cut that which of the two is most apparent.

The most apparent Vein is to be opened.

Howbeit in Diseases of the Head (if the Circulation did not persuade the contrary) the opening of the Cephalick Vein would help a little more, because there is a branch inserted thereto proceeding from the external jugular; which I have observed more than once in divers Bodies. But the Case is all one, because the Carotick Arteries exclude all this Difference.

From the Subclavian Veins there arise both upper and lower Veins; and the lower both before and after division: before the division, four.

1. The *Mammaria* (whose original doth notwithstanding many times vary) on each side one, sometimes without a fellow, descending into the Duggs, of which I have made frequent mention. This by way of *Anastomosis*, is sometimes joyned to the Epigastrica under the right Muscles of the Abdomen.

2. The *Mediastina* which comes to the Mediastinum and the Thymus.

3. *Cervicalis* for the Muscles which lie upon the Vertebra's and for the Marrow of the Neck.

4. *Muscula inferior*, for the lower Muscles of the Neck and the upper of the Breast, and this also arises sometimes, from the external Jugular.

The Subclavian Trunk, being gone out of the Cavity of the Chest, is then properly termed *Axillaris* and the *Scapularis duplex* doth from hence arise, for the external and internal muscles of the *scapula*, and for the kernels of the Arm-pits. Afterwards the *Axillaris* is divided into the upper branch or *Vena Cephalica*, and the lower or

Basilica

The FIGURE Explained.

This TABLE propounds the chief distribution of *Vena cava* through the whole Body.

- A. The Trunk of *Vena Cava* below the Heart.
 B. Its Trunk above the Heart.
 C. A hole whereby it gaps into the Heart.
 DD. The Subclavian Branches.
 ee. The mammary Veins.
 f. The *Vena Mediastina*.
 gg. The *Vene cervicales*.
 hh. The *Vene Vertebrales*.
 iii. The *Jugulares externae*.
 kkk. The *Jugulares internae*.
 Llll. The *Vena Axilla* or fine Pari.
 mm. The *Intercostalis superior*.
 nn. The *Rami phrenici*.
 ooooo. The Branches of *Cava* through the Liver.
 p. The *Scapularis interna*.
 q. The *Scapularis externa*.
 r. The *Thoracica superior*.
 s. The *Thoracica inferior*.
 T. The *Cephalica*.
 V. Its external Branch.
 X. Its internal branch which in part constitutes the *Mediana*.
 ZZ. The *Basilica Vein*.
 aa. Its first Bough.
 bb. The external Branch of the second Bough.
 ss. The internal branch of the second Bough.
 00. The third Bough constituting the other part of the *Mediana*.
 xx. The *Salvarella*.

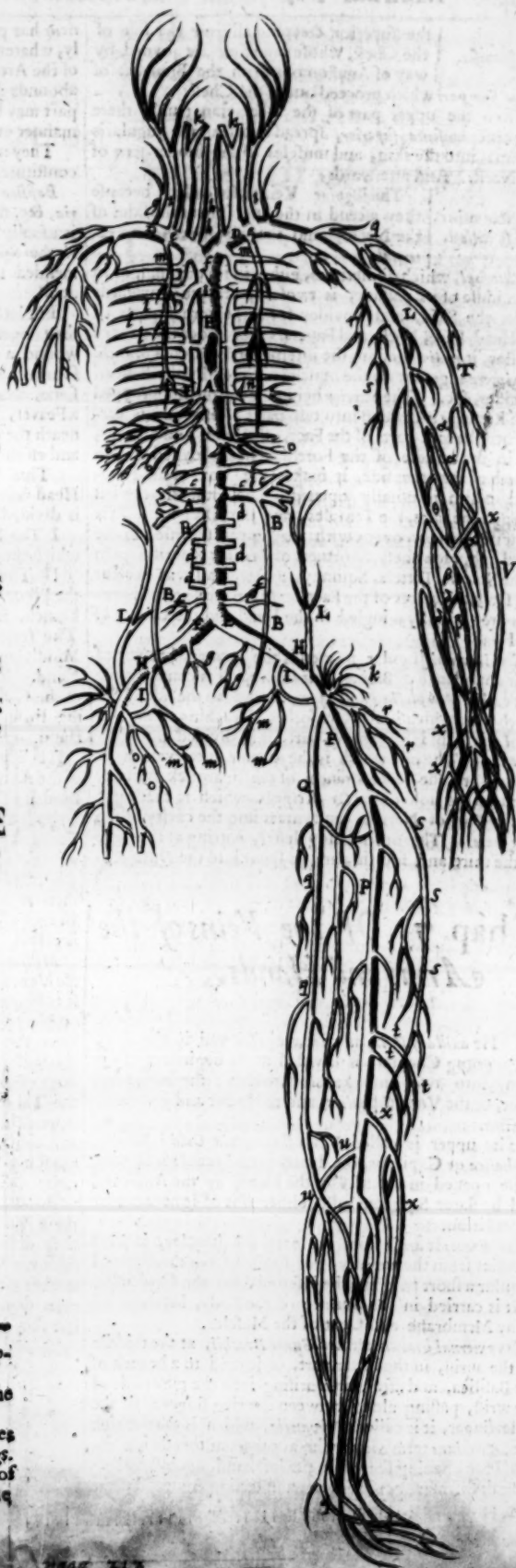
These following Characters design the lower Veins.

- AA. The *Emulgens Veins*.
 BEBB. The *Spermatick Veins*.
 ccc. The *Veins of the Kidney-kernels*.
 dddd. The *Lumbal Veins*.
 EE. The *Rami Iliaci*.
 ff. The *Muscula superior*.
 gg. The *Sacra*.
 HH. The *Ramus Iliacus externus*.
 H. The *Ramus Iliacus Internus*.
 kk. The *Muscula media*.
 LL. The *Vena Epigastrica*.
 mmm. The *Hypogastric Vena*.
 nn. The *Muscula inferior*.
 oo. The *Vena pudenda*.
 PP. The *Cruet Branch*.
 Qqqq. The *Vena Saphena*.
 rr. The *Ischias minor*.
 sss. The *Muscula*.
 ttt. The *Poplitea*.
 uu. The *Suralis*.
 xx. The *Ischias major*.

Basilica, as shal be said in the following Chapter touching Veins of the Head.

From the Axillary after its division from the Trunk of the *Basilica* arise two Veins.

1. *Thoracica superior* spent into the Muscles spread upon the Chest, and into Womens Dugs.
2. *Inferior* which sometimes grows out of the



Anastomoses. the superior creeping all over the side of the Chest, whose branches are joyned by way of Anastomoses with the Branches of *Vena sine pari* which proceed out of the Chest.

From the upper part of the subclavian trunk, there first arises *muscula superior*, spread out near the jugularis externa, into the skin, and muscles of the hinder-part of the Neck. And afterwards,

Jugular veins why so called. The *Jugular Veins*, so called, because they ascend in the Jugulum at the sides of the Neck; and they are *internal* or *external*.

External, which sometimes, either in its original, or in the middle of its passage, is twofold, creeping upwards under the Skin, and provides for the external parts of the Head, Face, Neck, and Fauces. For under the root of the Ear, it is divided into the internal and external branch. The internal goes unto the muscles of the Mouth, Fauces, Hyoides, &c. The exterior being under the Ear propped with kernels, is divided into two parts; one part is carried into the fore-parts of the Face, the Nose and Cheeks, and in the middle of the Forehead being joyned with a Branch of the other side, it makes the Vein of the Forehead which is usually opened. The other is carried through the sides, the Temples, and the Occiput. This the wise *Severinus* opens with very great success, in the Head-ach, Hoarseness, Shortness of Breath, Pleurisie, pain of the Spleen, Tetters, Squinzy, and which I was present and saw, in Varices of the Face. Mean while these branches are variously mingled in the Head and the Crown of the Head.

The *internal Jugular* in men is the greater, because of their abundance of Brains, but in *Beasts* it is contrarywise. Tis called *Apoplexia*, and does ascend to the side of the *Trachea*, to which it sends branches. Reaching to the *Basis* of the Skull in its hinder-part, it is divided into two branches. The one which is the greater, is carried backwards with the lesser branch of the *Carotick Arterie*, through the hole of the *Os Occipitis*, which is made for the sixth Pair of Nerves, and enters into the cavity of the *dura mater*. The other being lesser, entering at the hole of the third and fourth pore, is spent into the *Dura Mater*.

Chap. 7. Of the Veins of the Arms and Hands.

The *axillary Vein* as we have observed in the foregoing Chapter, is divided at the beginning of the Arm, into two remarkable Branches: the upper and lesser, or the *Vena Cephalica*, and the lower and greater or *Basilica*.

The upper is called *Vena humeraria Cubiti inferior*, *Cephalica* or *Capitalis*, the Head-vein, because it is wont to be opened in Diseases of the Head, by the Ancients, and by later Surgeons also either out of Ignorance or Superstition.

In *Brutes* it arises from the external Jugular, in Men allwaies from the axillary, yet so that from the external Jugular a short twig may be inserted into the *Cephalica*.

It is carried in the Surface of the Body, between the fleshy Membrane and Coat of the Muscles.

Its *external branch* termed *Funiculus Brachii*, at the middle of the wrist, in the lower part, is joyned to a branch of the *Basilica*, and afterwards arising into the outer side of the wrist, passing along between the ring finger and the little finger, it is called *Salvarella*, which is that which the *Arabians* term *Siele*, who as others at this day, commend the opening thereof in the left hand, against melancholick diseases, acute Fevers, and tertian Agues, but in vain, and upon no ground at all. As *Joh. Bapt. Sylvan-*

sicus has proved in a distinct Treatise, and *Severinus* lately, whatever *Spirit* may dispute touching Anastomoses of the Arteries, in the extrem parts, wherewith the Spleen abounds: For the Spleen is more remote, and any other part may be as well opened, for there are Anastomoses in a manner every where.

They make that the inner branch of the *Cephalica* which constitutes the *mediana*.

Basilica by some call'd *Cubiti interior*, *Epatica*, *Jecoraria*, &c. the Liver vein, because in diseases of the Liver it is usually opened: but in the left side tis termed *Lienaria* the Spleen vein because the opening thereof is commended in Diseases of the Spleen, upon no ground at all.

But let Surgeons take heed when they open this Vein, lest they wound a Nerve of the third and fourth pair, which lies near the same, whence follows great pain, a Fever, Convulsion, and Death. Also Arteries lie beneath the same, which being hurt, causes an *Aneurisma* and effusion of Blood.

This Vein is divided into more Boughes then the Head vein. Under the tendon of the pectoral muscle it is divided into three Branches.

I The first goes along with that Nerve of the Arme, which they call the fourth.

II The next is termed *Medius* and *Profundus*, beneath the Elbowe Joyned divided into an. external and an internal branch, separated but a little way one from another. The former provides for the Thumb, Forefinger, and Middlefinger; as also for the external muscles of the Hand. The latter being stretched along the middle bone of the Cubit, serves the Middlefinger, the Ringfinger, and the little finger, as also the internal Muscles of the Hand.

III The Subcutaneous is divided at the inner swelling of the Arm, is divided into a foremore and hindermore Branch: The latter descends under the Ulna by the little finger, where it is joyned to a Branch of the *Cephalica*. The former as it passes along the Cubit, produces another remarkable Vein, which proceeds sometimes directly, otherwhiles with various turnings unto the wrist. And then as it is carried along the Cubit, with the inner Branch of the *Cephalica*, it makes a common Vein which is called

Mediana by *Avicen* *nigra*, tis call'd the *mediana* or middle Vein because of its Situation in the midst of the Arm. It is frequently opened without danger, because there is no Nerve beneath it, but only the Tendon of a Muscle. From this or rather from that part of the *Basilica*, whence this arises, a branch is sent forth, which being divided above the *Radius*, produces an exterior branch, between the Thumb and the Forefinger, which some call *Cephalica*, others *Ocularis*, and some again as *Mundinus*, *Salvarella*, and another more inward, betwixt the middle finger and the Ring finger, which some as *Rhassis* count the *Siele* or rather *Silem* of *Avicenna*.

But touching the Distribution of all these Veins it is to be observed, that they differ in several Bodies, and are seldom in one man, as they are in another; yea the right side of the same man does rarely agree with the left; and in like manner they vary in Magnitude, in several persons.

The Variation of the Veins of the Arm.

CHAP. VIII. Of the Trunk of Vena ca- va descending as far as to the Thighes.

THe lower Trunk of *Vena Cava* proceeding out of the Liver, called the descendent Trunk, is more narrow then the upper or ascendent (which serves very many parts) and proceeds undivided accompanied with a great Arterie, as far as to the fourth Vertebra of the Loyns. Mean while it sends forth these following Boughes.

I The *Vena adiposa* which serves the Coat of the Kidneyes and their Fat, the left of which, is commonly higher then the right.

II The *emulgent Veins*, descending to the Kidneyes by a short and crooked passage, sometimes with a threefold Rise, bringing back the wheyish Blood being purified from the Kidneyes into the *Vena Cava*.

3. The *Spermatick Veins* of which in the first Book.

4. The *Lumbago* or Loyn-veins, sometimes two, sometimes three, which are carried betwixt the four Vertebra's of the Loyns. From these *some* write that they have observed two Veins ascending, within the Vertebra's, on each hand to the side of the spinal marrow in the Brain, which makes them conjecture, that a portion of the seminary matter is brought from the Brain.

These being thus constituted, the Trunk going towards *Os sacrum*, at the fourth Vertebra of the Loyns, it goes under the Aorta, which before was under it, and is divided into two equal Branches, termed *Rami Ilij* or *Iliaci*, because they go over the *Os Ilij* and *Os pubis* unto the Thighes.

About the division it self, there arise two Veins; the *Muscula superior* serving the Peritonæum and the Muscles of the Loyns and Belly, and the *Sacra*, sometimes single, otherwhiles double, for the Marrow of *Os sacrum*.

Afterward the *Ramus Iliacus* is forked out on each side into the external greater, and the internal lesser.

From the inner two Veins sprout; the *Muscula media* without, serving the Muscles seated on the outside of the Hip, and the skin of the Buttocks; and the *Hypogastrica* which is remarkable, sometimes double, serving very many parts of the *Hypogastrium*, as the Muscles of *Intestinum vesicæ*, whence are the *Hæmorrhoides externæ*; the Bladder and its Neck, the Yard, the lower side and neck of the womb, whence are those Veins by which menstrual Blood is many times thought to be purged in Virgins and Women with Child; which nevertheless seldom happens, when the *Vena Hypogastrica* do cumulate thick Blood, and send it not back unto the Trunk, then they may be opened, but otherwise, they are indeed suppressed; but they ascend unto the Heart by the *Vena Cava*, and cause palpitations and other symptoms. But when they are right, the Courses are naturally voided by the Arteries, which appears by their florid color, and the common Office of the Arteries, which is to carry unto the parts of body. *Waleus* proves this also by other tokens in his Epistles. This branch when it is joyned with the crural branch internal, doth cease.

From the outer, three: two before it goes out of the Peritonæum, and one afterward: the first is the *Epigastrica* (which seldom arises from the crural) to serve the Peritonæum and Muscles of the Belly; the chief part ascends, under the right Muscles to the Mammariæ, to which they are often joyned about the Navil.

2. The *Vena pudenda*, which serves the Privy Parts in

Men and Women; it goes athwart to the middle of *Os pubis*.

3. *Muscula inferas*, going over the side of the Hip-joynt, to serve the Muscles and skin of that part.

Afterwards its Branches are termed Crurals.

Chap. 9. Of the Crural Veins.

THe *Vena Crurales*, as also the Arteries and Nerves passing along, are in the bending of the Thigh interwoven with frequent kernels, for firmness sake. Afterwards there arise from the crural Veins six branches.

1. *Saphada* (so cal'd because of its apparency more than other foot-Veins) or *Vena maleoli* the *Ankle-vein*, is long and remarkable, it is carried along in the Inside of the Thigh, with a Nerve stretched by it, between the Skin and *Membrana Carnosa* to the Knee, and along the inner part of the Leg, it goes to the inner Ankle. And it is variously distributed into the upper parts of the Foot, towards the Toes, especially the great Toe. This is opened about the Ankle, in Diseases of the Womb, especially when the Courses are stop'd, and in the Gonorrhæa to evacuate or revell the Blood which otherwise would ascend too plentifully unto the Womb and Genitals. Now it must be opened where it is most apparent, whether it be on the Back or side of the Foot.

2. *Ischias minor* is opposite to the former. for it is a short outer branch, springing from the crural: it is carried outwardly and athwart into the skin of the Hip, and the Muscles of that place.

3. *Muscula*, arises from a Trunk, which lies hid among the Muscles: it is a double and remarkable Branch distributed among the Muscles seated in the Thigh.

4. *Poplitea* the Ham-vein, is made of a double Crural branch mingled together, and runs streight along under the Skin, behind, through the midst of the bending of the Ham, as far as to the Heel, sometimes to the Skin of the Outer Ankle. This Vein is commonly supposed to have been frequently open'd by the Ancients, under the Knee, and *Paulus Magnus* a Chyrurgeon of Rome, did once open it. But because it lies exceeding deep, and cannot be seen, we must suppose it cannot be opened: and perhaps this is not the *Vena poplitea* of the Ancients, especially seeing *Galen* is exceeding various in his description thereof, and calls it sometimes the Vein in the Ham, sometimes about the Ham, sometimes at the Knee, otherwhiles under the Knee; peradventure he meant the Ankle-vein, which descends to the inner bunching of the Leg, and is indeed conspicuous enough under the Knee.

5. Is cal'd *Suralis*, which is a great Vein; and is divided into the external and lesser, and the internal and greater branch, and each of them again into exterior and interior. It is distributed amongst the Muscles of the calf of the Leg. On the back of the Foot, being mixed with the branches of the *Poplitea*, it makes that same various texture of Veins, which is apparent under the Skin.

6. *Ischias Major* gives a part to the Muscles of the Calf, and then spends it self into ten branches, bestowing a couple upon each Toe.

Touching all these it is to be noted: 1. That all these branches, do send divers tigs outwards to the Skin, which are termed Skin-veins.

2. That all these branches are diversly disposed in different men, as was said in the Arms; nor is there alwaies the same carriage of Veins, in both the Legs of the same person.

3. That there is also no great choyce to be made in opening the Veins of the Feet; seeing they are all derived from one Trunk, and the Blood ascends from the extreame parts and Arteries.

THE
SECOND MANUAL
Of the Arteries,
Answering to the
SECOND BOOK
Touching the
Middle Cavity or Chest.

CHAP. I.
Of the Arteries in General.

The name
Artery.

Arteria an Artery so called from containing and preserving Air or spirit; was by the Antients *Hippocrates*, *Plato* and *Aristotle* the name of the Wind-pipe, which also *Hippocrates* calls *Arteria magna*. *Galen* makes a distinction and calls the Wind-pipe *Aspera Arteria* the rough Artery, and those whereof we are now to treat *Arteria levis* the smooth Arteries, which *Hippocrates* calls *Arterias parvas*, *Aristotle* sometimes *Venam Arteriam*, otherwhiles simply *Aorta*.

Now an *Artery* properly so called, is a common Organ, round, long, hollow like a pipe; consisting of a double Coat, proceeding from the Heart, fit to carry Blood and vital spirits to all parts.

The *Efficiens* is the proper Artery-making faculty, which may be called *Arteropoesice*.

The matter whereof it is made, is a clammy and cold part of the seed, according to *Hippocrates*. And this is the Beginning of its Generation.

The Beginning of its Dispensation, is not the Brain, as *Plato* *Galen*'s Master would have it, but the Heart by the Consent of all Philosophers and Physicians. And indeed the Arteries proceed out of the left Chamber or Ventricle of the Heart, not the middlemost, which *Aristotle* assigns to himself, and would have the Aorta to proceed therefrom. And therefore the *Arteria magna* proceeds from the Heart, as also the *Penula Arteria*, and the *Vena Arteriosa*, but these out of the right Ventricle; of which we have spoken already in the second Book.

Their End or Use is, 1. Inasmuch as they are Conduit-pipes, they carry the Blood and vital or arterial spirit made in the Heart (for Spirit alone without Blood is not contained in the Arteries) to all parts of the Body. 1. To communicate life or vital faculty, that the vital spirit implanted in the parts, and their Native heat may be sustained and cherished. 2. That animal spirit may be bred, in the noble Ventricle of the Marrow. 3. For the nourishment of all the parts, which are nourished by these only and their Blood and not by the venal Blood or Veins. 4. To carry the Excrements of the Body and the Blood therewith mingled, either to the outer parts of the body to the Kidnies, or the Mesentery, or the Womb, or the hæmorrhoid Veins, &c.

II. Inasmuch as they are moved and pulse perpetually; they afford this benefit. *Why the Arteries pulse.*

1. That the heat of the parts is fanned, cooled and tempered, and so a symmetric or due proportion of Heat is preserved, which is caused, not so much by the Airs being drawn in, when the Artery is widened, to avoid Vacuums, as by the arterial Blood continually flowing in, impregnated with Air. 2. That this nourishing arterial Blood, may be continually poured into the smallest Arteries, and from thence into the parts of the Body. For in the first place, the Heart by continual pulling, drives the Blood into the greater Arteries, which because they cannot let it return because of the Valves, and are too strong to break, it must needs be driven to the very smallest Arteries and the parts of the Body. And those parts not being nourished with all that is forced in, do send back that which is superfluous into the Veins, that so it may be circulated. Moreover, an Arterie being bound in any part of the Body, it is filled towards the Heart, otherwise than the Veins; contrariwise towards the smallest Arteries and the parts it is emptied. Thirdly, In Blood-letting, the Arm being indifferently

rently hard bound and the pulse remaining, the Arm is filled, and a Vein being opened below the band, Blood plentifully issues, which because it cannot come out of the Veins which lying higher are stopped by the Ligature, it must needs be brought from the Arteries beneath. Fourthly, in live-Creatures dissected, this Tumor of the Arteries is observed near their Original, and a lankness towards the extrem parts of Body, into which they go; and when they are opened, there is a mighty flux of blood, on this side the band, none beyond it. Lastly, the same is to be seen by an Aneurisma. 3. Least the Blood of the Veins to which they are joyned, should be still, and putrifie like standing waters, and that the Heart may not be destitute of Blood in its continual expulsion, by the driving Arteries it is continually filled again through the Veins.

The Pulse how caused.

This Motion of the Arteries called the Pulse, is caused, either by the faculty alone, whether seated in the Arteries themselves, as *Praxagoras* would have it, or flowing from the Heart by the coats of the Arteries, as *Galen* and infinite Physicians after him have taught, especially by reason of a little Reed put into the Arteries, under which they are not mov'd, by reason of the Interception of their coat, til it be taken away. again, because as the Heart is contracted and widened, so are the Arteries, as appears by laying one hand to the region of the Heart, and the other to the Wrist, and by wounds in the Heart and Arteries: or by the Blood either boyling according to *Aristotle*, or rarefied according to *Des Cartes*, or merely distending as *Harvey* hath proved: or from both the Blood filling, and the faculty directing, which is my opinion. For that the Arteries are moved and distended by the Blood, I prove. 1. The Heart by its perpetual pulsing, expels great store of Blood, as I have demonstrated in my Chapter of the Heart. 2. That the same Blood doth fill and move the Arteries, the Artery it self shews, being laid bare, into which at every pulse, you shall feel with your fingers the Blood driven in to flow down, with which it is dilated. 3. When an Artery is opened, Blood leaps out, at every pulse, as out of the Heart. 4. *Harvey* saw a portion of the descendent Artery with two crural branches a span long taken out of the Body of a Gentleman, which was turned into a fistulous hollow bone, and nevertheless the Blood which when he was living, descended through the the Cavity thereof into his Legs, did move the Arteries beneath, by its impulse. The same hath been observed by others in the *Arteria Aorta*. 5. In an Aneurisma the flesh is manifestly seen to pulse, as formerly the Artery being sound was wont to do by the afflux of Blood. 6. The waving, Worm-creeeping pulse, do argue the same, in the judgment of *Waleus*. 7. *Harvey* gives us another rare experiment, made with the Guts of a Dog, Wolf or other Creature dried, blown up and filled with Water. For if we finite one end with our Finger, and lay our fingers to the other end, we may clearly perceive every stroke, and the difference of the motion. Howbeit I conceive the faculty ought to be joyned hereto, communicated to the Coats from the Heart, by help whereof, they are contracted and widned; because, 1. Otherwise the Flux of the Blood would be inordinate, and the pulse always unequal. 2. All the Arteries are dilated or contracted in one moment, but the Blood alone fills the Arteries successively and moves them part after part. Indeed, Gloves being blown into, all the fingers are puffed up at once, which *Harvey* objects, and in a Basin the blow and motion are at once in both ends: but corporeal blood is of another Nature, which cannot be moved like species or Winds. 3. The Faculties or Irradiation of vital light, may run through all parts in the twinkling of an Eye, like the Light of the Sun. See more of this in the Chapter of the Heart. 4. Hence within *Galen* his Reed the Artery is obscurely moved, because the swift motion of the Blood ceases when the Faculty is hin-

dred. Howbeit, *Harvey* and *Waleus* argue differently about this difficult Experiment.

Now all the Arteries are widened when the Heart is contracted, and contracted when the Heart is widened, which is certain from the dissection of an Artery and the Heart, and from Ligatures, nor was it so long ago unknown to *Erasistratus*, and reason confirms the same, because when the Heart expels, then are the Arteries filled with its Blood. Yet have they not contrary pulses, as we find by laying our hand to the wrist and the Region of the Heart, at one and the same time, for the pulse of the Heart is perceived by us in its Systole, but that of the Arteries in the Diastole, when they are filled, because the two motions, are at one and the same time. The smallest capillary Arteries are not perceived to pulse, because there is not so much force in them, and therefore we can hardly discern them from the Veins, also they have thin Coats, so that the Blood is seen through them, as through the Veins.

The Form is apparent from the Accidents; howbeit the form of an Arterie is the Substantial Soul, as it is of the whole Body besides.

Its Situation is deep, allwaies under the Veins, that they might be more safe, and that not only in the external, but the internal parts also, if you except the Belly, a little below the Kidneys: For after that the Vena Cava and the Aorta, descending from the *Diaphragma*, have passed the Region of the Kidneys, the Cava hides it self under the Aorta through all that region, til they pass out of the Abdomen; for then the Arterie does again hide it self under the Cava. The Cause whereof *Plempius* conceives to be this; that otherwise there would have bin danger, least the bending of the Body often happening in that place, the Vena cava having but a single Coat, would have resisted the said motion.

Its Magnitude is sufficiently great, but the descending part of the Arterle is greater, the ascendent lesser, because the Number of the internal parts is greater then of the external.

The Number of the Arteries is fewer then of the Veins, because the passage of the Blood is quick through the Arteries, slow through the Veins, and therefore there are many receptacles provided for that Blood which is collected by certain pulses. Yet there are more Arteries then we think, or can be discerned by us, because the capillary Arteries are exceeding like to Veins.

Their Shape is like a Pipe or Channel, smooth, round, and long.

As to their Passages. Some Arteries are terminated into the Guts, by which expulsion of Excrements is caused; some have their mouths terminated into the Skin, through which the external air is attracted (in Transpiration which is performed also by the Veins) and footy steams expelled. *Placerus* denies that they are inserted into the Bones, but *Spigelius* observed at *Padua*, in a great corruption of the *O. Tibie*, that the substance of the Bone was bored through by an Arterie, which perhaps *Aristotle* had likewise seen, because he says that Arteries end into a solid Substance.

They are compassed (like the Veins) sometimes with a membrane thick and common, from the Neighbouring parts, when they are without the Bowels and the Muscles; and such Arteries as have a membrane joyned to them with Nerves in it, do feel; whence *Galen* said the Pulse was inflamed, also that an Arterie did feel, and was pained, which one at *Padua* found in his inner parts, who dying with a mighty pain in his Loyns, Stones like a Mans Nails were found in his Lumbal Arteries. But other Arteries are without Sense.

The Substance of the Arteries is membranous, so that they may be distended and compressed more then the Veins. Falloping thought

Whether the Arteries are dilated together with the Heart or no.

Whether the Arteries do feel.

Their Substance.

their Substance to be gristly, because he observed that it did degenerate into a boney nature; which also *Veslingus*, *faw*, as well as *Harvey*, in the great Arterie above the Valves, near the Heart of an old Man. But that many

How many Coats an Arterie hath.

things are changed into a boney substance, which were not gristly. *Columbus* teaches in the *sepium Cordis*. Now an Arterie consists of two peculiar Coats.

The Exterior is thin, soft, rare, as the Coat of a Vein is.

The interior is compact, hard, and very thick, viz. five times thicker than the Coat of the Veins: And therefore *Hierophilus* said, that the Arteries were six times thicker than the Veins, for this Cause, that they might be strong in their perpetual motion, and that their thin Blood should not soon vanish and fly away, being spirituous and vaporous. And therefore in the opening of an Arterie, the incision must be made deep, with a broad and sharp Lancet, because of the deep Situation of the Arterie, and

Whether an Artery may be opened, and how.

thickness of the Skin. The opening of an Arterie is allowed of by these ancients *Oribasius*, *Egineta*, *Acinius*, *Aetharius*, *Aurelianus*, *Abensina*. With good success *Galen* practised it, in a disease of the Eyes proceeding from hot Blood, full of vapors, and in pains of the Hips. *Panazolus* at Rome uses the same kind of remedie in a Phrenzie, and *Alpinus* writes that it is frequent in *Egypt*, which *Paracelsus* did likewise exercise in France, *M. Aurelius Severinus* at Naples, and *Paulus Mosh* with us, excellent Physicians and Surgeons, do happily open them, to the great good of their Patients, especially in diseases of the Head; in which nevertheless, the opening of an Arterie may seem useless, because 1 Vaporous and hot Blood is as well carried by the inner carotick Arteries unto the Brain, from the Basis to the *plexus venosus*, as well as by the external ones, which are opened. 2 The same Blood returns through the jugular Veins, according to the sure Laws of Circulation. But seeing it did certainly profit the Patients, I conceive it was practised rather by way of preservation, then of Cure. For the antecedent cause being somewhat evacuated by the outer Arteries, the conjunct cause is easily extruded by the jugular Veins. More over, some external Vein or Arterie may be obstructed, so that neither the latter can send, nor the former receive, unless they be opened.

Galen adds a third Coat, in their inner Surface, like a Cobweb for Thinness, appearing in great Arteries about the Original.

Chap. 2. Of the ascending Trunk of the great Arterie.

The distribution of the Arteries which alwaies in a manner, accompany the Veins, will be more easy and short; because the deflemation of the Veins is already understood from what has bin said before.

The *Arteria magna* or *crassa*, the great or thick Arterie the mother of the other Arteries, comes out of the left Ventricle of the Heart with a gaping Orifice or wide mouth; where within the *Pericardium* or Heart-Bag, it breeds from it self the *Arteria*

Coronaria, compassing the Basis of the Heart sometimes single, sometimes double. afterward, going out of the Heart-bag, tis divided into the lesser Trunk ascending, and the greater Trunk descending.

The lesser and upper Trunk resting upon the Wefand, does provide for all parts quartered above the Heart:

and is divided into the *Subclavius Ramus dexter*, which is higher and much the larger, and the *sinister*, rising more low and going obliquely to the Arm.

Afterward the whole Trunk sustained by the Thymus, divides it self into two Carotides or Sleep-arteries unequal, which go right upwards.

The *Arteria subclavia* before they go out of the Chest (for then they are termed *Axillares* when they are out) from their lower part, do produce the *Intercostrales superiores* to the Intervals of three or four of the upper Ribs; from their upper part. 1. The *Mammaria*. 2. The *Cervicales*. 3. The *Muscula*.

From the *Axillaris* before it comes to the Arm, in the lower part, doth arise the *Thoracica superior*, *Thoracica inferior*, and *Scapularis*: in the upper part, the *Humeralis*. The remainder, goes from the Axillary on each side to the Arm.

CHAP. III.

Of the Arteria Carotides.

The *Arteria Carotides* do ascend upwards right to the Head by the sides of the Wefand, being knit unto the internal Jugulars: for the internal Veins do not accompany the Arteries. When they come to the Fauces, before they enter the Skul, they give branches to the Larynx and the Tongue: and then a division is made into the outer and inner branch.

The outer being the smaller, furnishes the Cheeks and Muscles of the Face; and then at the root of the Ears, 'tis divided into two branches; the one is sent to the hinder parts of the Ear, whence arise two branches entering the lower Jaw, to furnish the Lip, and the roots of all the lower Teeth: the other goes to the Temples, the Forehead, and the Muscles of the Face.

The inner at the saddle of *Ossis Sphenoides* under the *dura mater*, makes the *Reve mirabile*, and then passes through the *dura mater*, and sends forth two branches. 1. The lesser with the Nerve optick to the Eyes. 2. The greater ascending to to the side of the *Glandula pituitaria*, and distributed through the *pia mater* and the substance of the Brain.

Chap. 4. Of the Arteries of the whole Hand.

The *Axillary Arterie*, is carried along through the Arm, descending between the Muscles, with a Vein and Nerve of the Arm which they count to be the fourth.

Under the bending of the Elbow, it is divided into two fair branches; the upper and the lower.

The upper goes right on through the middle to the Wrist, where Physicians feel the Pulse; afterward proceeding under the ring-shap'd Ligament, it bestows branches upon the Thumb, Fore-finger, and Middle-finger.

The lower running through the Ulna to the Wrist; furnishes the Mid-finger Ring-finger and little finger: and so it proceeds to the Wrist, whence we feel the motion of the Pulse beneath, especially in lean persons, or such as have a great Pulse. But we better perceive the pulling of the former branch, because it is less obscured and hid by Tendons.

CHAP.

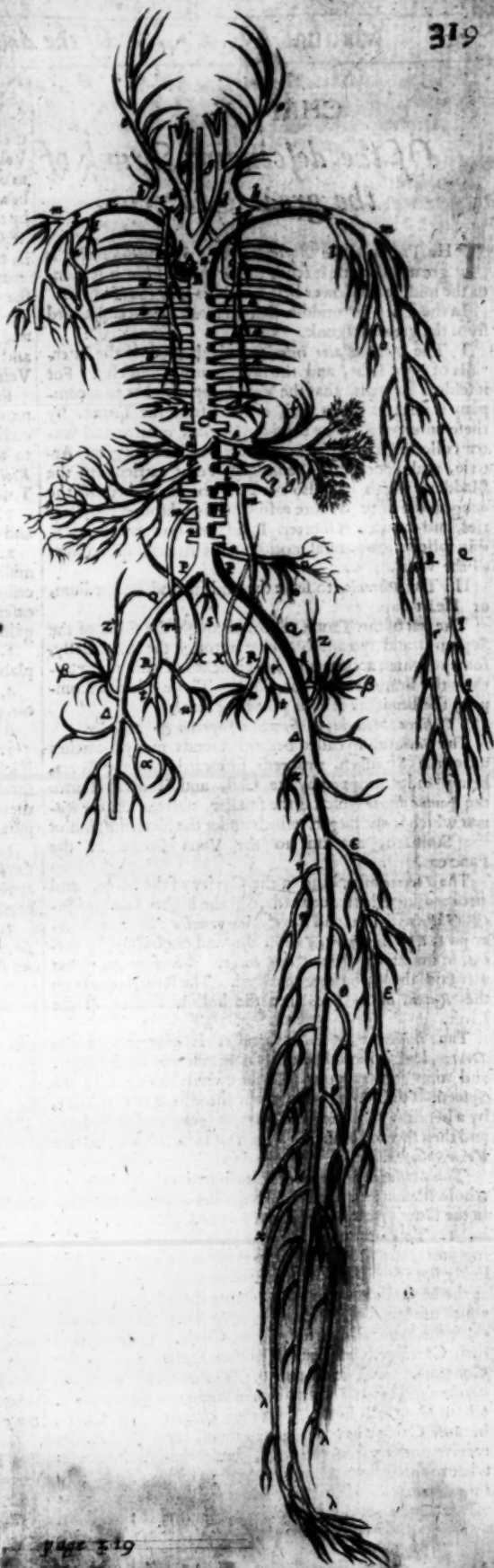
The FIGURE Explained.

This TABLE presents the distribution of the *Arteria Magna* or *Aorta*, through the whole Body.

- A. The Beginning of the *Arteria magna* arising out of the Heart.
- aa. Its Trunk ascending, from whence arise
- CC. The *Arteria Subclavia*, and from these
- dd. The *Arteria carotides*, which afterwards produce
- ee. The *Ramus exterior* and
- ff. The *Ramus interior*.
- gg. The *Arteria Vertebrales* or *Cervicales*.
- hh. The *Arteria Muscula*.
- ii. The *Arteria Mammaria*.
- kk. The upper intercostal Arteries.
- ll. The *Scapularis interna*.
- mm. *Scapularis externa*.
- nn. *Thoracica superior*.
- oo. *Thoracica inferior*.
- pp. The *Ramus axillaris*.
- Qq. Its upper branch dispersed through the Arm to the Wrist.
- Rr. Its inferior branch going also to the Hand.

These following Characters denote the Arteries which spring from the descendent Trunk.

- B. The Trunk of the Artery descending.
- aaaa. The lower Intercostal Arteries.
- bb. The *Phrenica Arteria*.
- C. The *Arteria Celiaca*.
- d. The right branch thereof.
- e. Its left branch or *Arteria Splenica*, sprinkled with very small twigs through the Spleen.
- f. The *Arteria Gastrica dextra*.
- g. The *Arteria Gastrica sinistra*.
- h. The *Arteria Epiploica*.
- kk. The *Arteria Mesenterica superior*.
- ll. The *emulgens Arteries*.
- mm. The *Spermatick Arteries*.
- nnnn. The *Arteria Lumbares*.
- oo. The *Mesenterica inferior*.
- pp. The *Rami Iliaci*.
- Qq. The *Arteria Iliaca externa*.
- Rr. The *Iliaca interna*.
- S. The *Arteria Sacra*.
- tt. *Arterie Hypogastrica* going to the *Arse-gus* and the *Privities*.
- uu. The *Hypogastrica* which go to the *Womb*.
- XX. The *Umbilical Arteries*.
- ZZ. The *Arteria Epigastrica*.
- ΔΔ. The *Arteria Cruralis*.
- αα. The *Arteria pudenda*.
- ββ. The *Muscula inferior*.
- εε. The *Arteria Muscula, Cruralis, externa*.
- κκ. The *Muscula cruralis interna*.
- θθ. The *Popliteus Ramus*.
- κκ. The *Ramus Suralis*.
- λλ. Branches sent upon the Foot and its Toes.



CHAP. V.

Of the descending Trunk of
the great Arterie.

THe Trunk of the *Aorta* or great Arterie descending is greater, because it sends out branches from it self, into the middle and lower belly, as also into the Thighes.

In the Chest or middle Bellie, two Arteries proceed from the greater Trunk.

I The *Intercostales inferiores* which go unto the Intervalls of eight Ribs, and the neighbouring Muscles. For it seldom happens, that the Vein sine pari, has to accompany it an Arterie sine pari, arising from the Trunk. By these intercostals if we baleive *Spigelius*, quittor and water collected in the Chest, are received into the great Arterie, and thence by the emulgent Veins carried into the Bladder, which has also reason to back it, because the congested matter is more easily hurried through the Arteries, and the way is shorter. I add that quittor more readily follows the natural motion of the Arterial Blood then of the vena.

II The *Phrenica* to serve the Midriff and Pericardium, or Heart-bag.

The rest of the Trunk peirces through the Clift of the Septum, and spreads branches through the lower Belly, some of which accompany the branches of vena portæ, others the Branches of Vena Cava. Those which accompany the Branches of vena portæ are three;

Caliaca Arteria, Mesenterica Superior & Inferior.

The *Caliaca*, so called because it sends many branches unto the Stomach, proceeds forward from the *Aorta*, being under propped by the Call, and is divided into the *Ramus dexter* which is the smaller, and the *Sinister Ramus* which is the larger, which under the hinder region of the Stomach, are knit to the Vena Portæ in the Pancreas.

The *Dexter* ascending to the Cavity of the Liver, and proceeding a little forwards, on the higher side produces *Gastrica dextra*, and the *Cystica gemella*; from its lower part, *Epiplœ dextra*, *Intestinalis*, and *Gastroepiplois dextra*, in imitation of the *Vena portæ*. therefore let what was said there, be here repeated. The Remainder from the *Ramus dexter* goes into the hollow surface of the Liver.

The *Sinister* or *Arteria Splenica*, is greater than the *Dexter*, least it should be easily obstructed by thick juyces, and that it may pour sufficient vital blood, into the Spleen. This Arterie drawn out into the *Vena Splenica*, by a bending and crooked Course goes to the Spleen, and then spreads branches after the same manner as the *Vena Splenica*.

The *Mesenterica superior* is distributed welnigh into the whole Mesentery, and constitutes the *Arteria Mesaraica*, in the Gut Jejunum, Ileum and part of Colon: whose use is, 1. To communicate native heat into the neighbouring parts, and those whereinto they are inserted. 2. In a sickly state to receive the Excrement of the whole body, as the Mesaraick Veins do, to empty them into the Guts, which use was first found out by *Spigelius*. 3. Some conceive the Mesaraick Arteries draw Chyle. 1. Because of their Carriage. 2. Because of their Ends. 3. Of their Contents. 4. The Authority of *Galen* in his 4. *de usu partium* and in his Treatise *An in Arteria sit sanguis* ch. 5. whom *Hofman* follows. But they cannot draw Chyle, because Chyle was never seen in them, and the Arteries receive nothing from the parts, but communicate somewhat to those parts whereinto they are inserted. Nor do they draw to the Heart, as *Varolius* would have it, for the valves hinder; and the Chyle is not natural to the Heart.

Nor to the Liver or Spleen, as others suppose, because only the *Splenick Arteries* do carry vital Blood to the Spleen, and there is only one little Arterie implanted in the Liver. Nor is it returned out of the Arteries into the Veins, as *Spigelius* imagines, for so there would be labour in vain; Nor do they carry this Chyle to the *Caliaca*: because nothing ascends by the Arteries, but all descends by them to the parts. Therefore 4. The true use of the *Mesaraick Arteries* according to the Principles of *Waleus* is, to carry Arterial blood to the Guts, for their nutriment. Which motion of the Humors, Ligatures do shew in live-Anatomies. For the Mesaraick Arteries being bound, do swell towards the Trunk and the Heart, and are empty towards the Guts, which suck in the blood, and send back what is superfluous, through the mesaraick Veins to the Liver.

For the Blood is also circularly moved in the Abdomen, out of the coeliac and mesenterick Arteries, into the *Vena portæ*, notwithstanding *Riolanus* his denying the same, by his motion through the Tunks, because

Whether the Blood of the Belly be circulated.

1. There is the same Necessity which is in the Heart and other parts, the same Profit and the same Urgency.

2. Seeing there is an impulse of Blood without intermission, into the Mesaraick and Coeliac Arteries, of necessity, they must either break, or Tumors and other Diseases must arise in the Mesentery, or it must run back against to the branches of the *Portæ*.

3. Ligatures demonstrate the same here, as in other places.

4. The Valves observed by *Harvey* in the *Ramus splenicus*, permit the Blood to run back by the *Vena portæ*.

As to the contrary reasons it is to be observed.

1. That the Blood of the *Vena portæ* is not so impure, if it be compared with that of the *Cava*, but that it is sometimes purer than it; and though it be more dreggy, there is the more need for it to run back, to be made more pure by the Liver and Heart.

2. That there are in the Liver Anastomoses either of the *Vena portæ* and *Vena cava* (though they are not so apparent in a dead body) or such as open into the parenchyma of the Liver.

3. Sometimes there is a remarkable palpitation of the *Arteria caliac* in hypochondriacal disorders, which also *Mercatus* and *Fernelius* have observed, without any mutation of the Pulse, viz. the Hypochondrium being ill affected with Wind, or with some distemper, whereby the same Blood coming from the Heart, may be changed in this Region: but that by the Palpitation of the lower parts, the Heart is many times changed, *Tulpius* hath an Example. See also other Arguments, learnedly refuted by *Slegelius*.

The *Mesenterica inferior*, is distributed into the lower part of the Mesentery, and the left side of Colon.

But the other Arteries which accompany the Branches of *Cava*, are these following, excepting the *Mesenterica inferior*. For in this order the branches break forth from the *Arteria magna*, in the lower Belly. 1. *Celiac*. 2. *Mesenterica superior*. 3. The Emulgent. 4. The Spermatick. 5. The *Mesenterica inferior*. 6. The Lumbar; from which two Arteries are thought to accompany two Veins of the Brain. 7. *Muscula superior*.

Afterwards the *Aorta* at the beginning of the *Os sacrum*, goes above the *Vena Cava* and no longer under, least uniting against some Bone in its perpetual motion, it should be hurt; also that the fore-parts, the shops of generation, because of their need of Heat, might be near the great Arterie. And in this place it is called

Iliaca, where it is divided like the *Cava* into the two *Iliac Trunks*, and each of them into the inner and and lesser branch, and the outer and greater which go to the Thigh.

But before they become crural, they send out on each side

Give six branches. The *Sacra* presently after the bipartition: from the inner Trunk the *Muscula inferior*, the *Hypogastrica* and *Umbilical Arteries*; from the *Epigastrica* and *Peduncle*; The rest of the Artery is carried into the Thigh and makes the *Crunal Arteries*.

Chap. 6. Of the Crural Arteries.

of the Crural Arteries, on each side, are constituted the following Arteries.

Above the Ham, for the exterior part of the Thigh, *Musculus cruralis externus*, to the forepart Muscles of the Thigh, from the inner, the *Musculus cruralis internus*, to the inner Muscles of the Thigh; and this is innervated at the Knee, with a small branch or twig of the Hypogastrica.

Under the Ham arise three branches :

1. The *Popliteus*, into the hinder Muscles of the Thigh.
2. The *Sartorius*, which is divided into the *Tibialis anterior*, the *posterior alius* and *posterior humilis*, for the Muscles of the Leg.
3. The rest is spent upon the Foot and its Vessels.

THE THIRD MANUAL Of the Nerves, Answering to the THIRD BOOK OF THE HEAD.

CHAP. I.

Of the Nerves in General.

The significations of the term Nervus.

BY the Term *Nervus* the Ancients did sometimes signify a Ligament or Band, hence the Comedian saies, he will come to the Halter, *in Nervum ibit*: but it properly signifies a common Organ, which together with animal spirits, carries the faculty of moving and feeling, wherefore *Aurelianus* calls the Nerves *sesuales viae*.

A Nerve therefore is a common Organ long and round, to carry the Animal faculty lodged in the Animal Spirit, into the parts of the Body.

The Efficient is the Nerve-making faculty.

The Matter according to *Hippocrates*, is a clammy and cold part of the Seed, heated but not burnt: and *Galen* saies 'tis a matter white, thick and roapie. And this is the Beginning of its Generation.

The Beginning of the Dispensation of Nerves or the part whence the Nerves immediately arise, is the *Medulla oblongata*, partly as it is within the Skull, and partly as it is in the Back-bone. Within the Skull arise those which are commonly said to arise from the Brain, viz. the seven pair of Nerves: and in the Back-bone thirty. And this most true opinion is confirmed, not only by the similitude of the Marrowie and Nerve Substance, but also by ocular experience.

Aristotle would have them arise from the Heart, who is followed by *Alexander*, *Averroes* and *Aponefis*, who nevertheless say it comes by mediation of the Brain.

Others would have the Nerves to be nothing else but

the Veins and Arteries continued, and degenerating into Nerves: as *Praxagoras* of old, in our daies *Cesalpinus*, *Reusnerus*, *Hofmannus*, and *Martinius*, but they are out; seeing 1. In the Brain there is no Conjunction of Arteries and Nerves by Anastomoses. 2. An Artery being hurt or cut in the Head, no Convulsion follows. 3. The distinct Rise of the Nerves in the Brain is apparent, as of the Arteries in the Heart.

Erasistratus did conceive they came from the *Dura Mater*. At this day many Physicians conceive with *Galen*, that some Nerves arise from the Brain, others from the Spinal Marrow: who are all confuted by *Ocular inspection*.

Their End and Use is, to carry the Animal faculty with the Animal Spirit, from the Brain, like conduit pipes, into the parts.

1. Sensory, as the Eyes, Ears, &c.

2. Motive, as the Muscles.

3. All in a manner, that they may in general perceive and understand what causeth pain.

And therefore the Nerves inserted into the parts, do give to the said parts either Sense alone, or Motion alone, or both Sense and Motion: nor is there any voluntary motion or sense without the help of a Nerve; and therefore a Nerve being cut, that part is presently deprived of Sense and Motion.

The Nerves therefore, I say, do afford whether the motion to the parts either Sense or Motion, according as they are disseminated into the sensitive dis- such and such parts, because the Nerves for of themselves are not sensitive or motive.

So that if they be implanted into Muscles the Organs of Motion, they are termed motive Nerves; if into the Instruments of sense, sensitive. Many times also according to the Nature of the Parts, one pair of Nerves affords both sense and motion. As the sixth pair of the Nerves of the Brain, commonly so called, is communicated to the Bowels of the middle and lower Belly to cause the Sense of Feeling; and when it becomes recurrent, it bestows motion

motion upon the Muscles of the Larynx: The optick part so called, gives only sense, because implanted into the Eyes only. But the other part which is termed *motorium* part, the moving part, and arises from the marrow as well as the former, causes motion because it is implanted into the Muscles of the Eyes.

The Situation of the Nerves, for securities sake, is more profound and deep than that of the Arteries.

The Magnitude is various, according to the condition of the Organs and dignity of the Actions, their Assiduity and Magnitude. The optick Nerves are great, because the action of the Eyes is so; also those Nerves are most thick which are sent to remote and many parts, as the Limbs; indifferent in the sensory parts; for because they were to be soft, they could not be very small: the Nerves of the nearest parts are smallest of all, as in the Muscles of the Face.

The Nerves are commonly said to be seven and thirty part in number; seven part from the Brain, which I say arise not from the Brain, but from the *Medulla oblongata* within the Skull, and thirty from the Marrow in the Back-bone. But I say that indeed & in truth, those seven part, are ten

part, as shall be made apparent in the following Chapter and so I make forty part of Nerves: ten arising within the Skull, and thirty without in the Back-bone.

The former were indeed by the Ancients reckon'd to be only seven in number, and to arise from the Brain, which they comprehended in this verse.

*Optica prima, Oculos movet altera, tertia gustat
Quartaq; Quinta audit, sexta est, septima lingue.*

*First sees, next moves the Eyes, third, fourth do tast,
Fifth hears, sixth roams; seventh moves the Tongue too fast.*

But the smelling part was by them omitted, and that which they make the third part, is double and distinct; so the fifth is double; one part of which duplicity, some have made to be an eighth part; for *Archangelus* reckon'd eight part, *Columbus* nine, and I ten, as shall be said hereafter.

Now the thirty part of the Marrow of the Back are so divided, that seven are of the Neck, twelve of the Chest or Back (others say eleven) five of the Loyns (sometimes four) and six of the Os sacrum.

All these Nerves do sprout out of both sides, and therefore they are termed *Pares of Nerves*, *Synjugii* conjugations or coupling of Nerves. And it is necessary for a Physician to know their originals and distinctions, that he may understand to which part of the Back-bone To-picks are to be applied, when motion or

sense, or both are impaired in the Face, Neck, Hands, Muscles of the Belly, Yard, Fundament, Womb, Bladder, &c.

Moreover as to number, you must know that every Nerve hath its mate or Companion, except the last or lowest proceeding from the spinal Marrow.

The figure of the Nerves is long, round, and smooth like Conduit pipes; but without any hollowness as the Veins and Arteries have: because the later with Spirit were to carry Blood, but the Nerves carry only Spirit.

Riolanus the Father excepts the Nerves of the Privy manifestly hollow, which nevertheless his Son excuses to have been meant of the hollow Ligaments of the Privy; who is better vers'd in Anatomy than his Father was, and so also *Laurentius* spoke. *Severinus* in his Zootome. saies; the Nerves of a Bulls pizzle are hollow.

Galen also adds the Optick Nerves, which he will have to be hollow and perforated, sensibly and manifestly: for

the discerning whereof he conceives three things are necessary, viz. That 1^o The Animal be great. 2. That it be cut up as soon as killed. 3. That the Air be clear and bright. *Plempius* doth also require three things more, that the Nerve be cut asunder with a most sharp Knife, that it be not squeezed nor stretched; and that it be cut beyond the growing together of the two Nerves. *Cornelius Gemma* subscribes to *Galen*, who attributes rather a passage to be seen like a prick in the inner substance of the Nerves.

Others conceive the porosity is better seen in the optick Nerves being boiled. *Fallopian* saies that *Galen* thought thus, because in the Bodies of Apes which he dissected, all Nerves are pervious. Howbeit *Spigelius* admits only certain passages in the beginnings of Nerves, where they grow together, and soon after towards the Eyes it vanishes. I also saw a Cavity and Publicly did shew the same in a dead body, after they were joyned, and before they entered into the Eye.

But *V. salius*, *Eustachius*, and *Caiterus*, deny these Nerves to have any Cavity against *Galen*, and so do others, and produce experiments which succeed not, unless the conditions aforesaid be observed.

All the rest of the Nerves do want a manifest Cavity, but they have Pores; through which the subtil spirit passes, at least we should grant penetration of bodies which is impossible. These pores are double according to *Hogeland*, lesser and greater, through the former subtil aërial bodies pass to move the parts; by the later, bodies less subtil. Neither of them is discernable to the Sense. Nor are there two sorts of Spirits in the Brain. I am rather apt to believe that according to the Indigence of every part and the pleasure of the will and the Imagination, sometimes more spirit passes through the greater, sometimes less through the lesser, which the more plentiful or scanty influx of the Spirit doth make.

Moreover all the Nerves do consist, none excepted, of many nervous fibres or filaments which grow mutually together by little Membranes. I may self, with *Johannes Leennicus*, a right diligent Anatomist, have observed the Trunk of Nerves near the Hips, if it be dissected, to shew a Cavity as it were, consisting of an infinite contexture of fibres, like little Worms, whereas elsewhere it is one continued body, with cohering and continued fibres.

The Substance of the Nerves is thought to be threefold: the internal, white, and marrowish (by which as the Centre the action is performed) from the marrow of the Brain, but more compact and thickened; and an external, being a twofold coat, the outer harder, proceeding from the *Dura Mater*; the inner finer, from the *Pia Mater*. Which Membranes do the same for the Nerves, which the *Dura* and *Pia Mater* do for the Brain. Howbeit this distinction of Substances, is to be searcht out, rather by Reason than by Sense.

Cavestius supposes that there are Valves in the Nerves, which stop the Spirit that it may not flow back; otherwise the parts cannot be moved. But it seems to me, the Spirits may not be retained in the parts, which the Soul that directed the Spirit as far as to the Valve, shall direct it into the very parts. For so Anatomists as yet hath observed any Valves. Nor can subtil Spirits be stopped by Valves. Nor would Apoplexies or Palsies so easily happen, if the Spirits could be detained in the parts by Valves.

Besides Valves *H. Regius* introduces likewise a circulation of the animal Spirits in the Nerves. For after they are distributed from the Brain to the whole Body, he conceives part is dissipated by insensible Transpiration, and part being insinuated into the Veins, is mingled with the Blood, and returns with it into the Heart; and thence again into the Brain and Nerves. He proves this by the example of a Snail enclosed in a glass, in which the spirits through its transparent Body, are seen to move and pass from the Tail through the Belly, to the Head; and from the Head through the Back, to return to the Tail, and from thence to the Head again.

But some doubts with-hold me from assenting to this witty conjecture, because

1. *Wileus* searching out the Motion of the Animal Spirits with all his diligence, could finde nothing but the motion and distention of the Muscles. For the Nerves being bound, do not swell, nor are distended, and being cut in disorder, they shew no other motion, but that they are contracted into themselves.

2. There is no need that the Spirits should run back to the Veins, because being subtile they are easily consumed, and by his own Confession do insensibly exhale.

3. New Spirit is evermore supplied from the Brain, which may supply the Defect of that which is consumed.

4. The Veins need none, because they possess that spirit which is proper to the Blood, nor are they moved with animal motion.

5. The Nerves themselves are not moved by Systole and Diastole, nor of themselves as was said, because it appears not when they are bound, and they move with a voluntary motion by the Muscles, and not by the arteries because they are smaller and go not into them: finally the Nerves are unfit for such a motion because of their Slipperiness.

6. In a Snail the Spirit aforesaid is instead of Blood, which Snails have not.

7. I have seen those who had their senses perfect, and the motion of all their parts free to the last gasp, whose Pulse did nevertheless intermit for certain daies, where there was no regress of the Spirits to the Veins, freely passing nevertheless from the Brain to the parts of the Body, as long as there was any left.

It is now to be observed that all the Nerves are not alike hard or soft; whence *Galen* reckons some Nerves soft, others hard: the former he calls *sensitive*, the later *motor*. Now the Nerve become harder,

1. Because of their *Production*, as being to go a great way, or through some hard Body, or by a crooked way. And by how much they are further from the Brain, by so much the harder they are. Hence the short Nerves, as those of the Sight, Taste, Hearing are soft, and those of the Smelling softest of all.

2. For *Use*, for hard Nerves are held to be fitter for motion, soft ones for sense. And therefore the Organs of the Senses have received soft Nerves, that they might be the sooner affected by a sensible object occurring. Now all parts which have voluntary motion have hard Nerves, because that which is hard is fittest to act, that which is soft to suffer.

The Use therefore of all the Nerves is,

1. To carry animal Spirits to all parts for sense and motion, which appears when they are hurt. For if they are obstructed in the beginning or totally, they both perish and an *apoplexy* is caused: or in part, and then one part of the Body is deprived of sense and motion. If they are cut asunder, the motion of that part is lost, into which they were inserted.

2. To diffuse Animal light into the parts. For the animal Spirits could not so soon be taken away, either in a Ligature, or Obstruction of the Nerves, but that those Spirits which remain in the part, might cause motion or sense. Therefore the direction of the Brain proceeds from some what else, which being taken away, the parts presently cease from performing their functions, even as the Hammer is by the Hand directed unto the Anvil, and a Staff is directed when it is hurled, which others endeavour to explain by some hot Accident beside the Animal Spirit. But I suppose these things are done by a light which irradiates from the Brain, with the spirits, which being intercepted, the parts are immediately deprived of Sense and Motion, as the light of the Sun is taken away by a Cloud, and the light of a Candle, by holding a mans hand before it. For,

1. No other influent cause, can flow in so suddenly, and be withdrawn so suddenly.

2. Light is the cause of all motion, well near in the Universe, and nothing is swifter than it is.

3. Sometimes it remains after interception, but not long, as light received into the Bononian Stone, and a Stick by me violently darted, and broken in the middle way, does fly yet further, by the motion impressed from my hand.

3. The Temper of the Body follows the Figure, and Temper of the Nerves, and therefore *Joh. Damascenus* in the seventh Aphorisme to his Son, advises in giving of Medicaments to avoid such as dissolve the force of the Nerves.

Chap. 2. Of the ten Pare of Nervi, which arise with in the Skull, from the Medulla Oblongata, and their progress.

I Make the first Pare to be *Par Olfactorium* the Smelling-pare, whose processes are termed *Mammillares*. And these processes have been sufficiently known to all: but the Nerve, to which they are fastned behind, and well near continued, to none or very few.

These Nerves slip out of the Marrow about the Saddle of the Sphenoides, near the foremore Venaricles, and have the carriage, colour, and use of Nerves, and therefore I reckon them for Nerves.

For they must not therefore be robbed of the Name of Nerve, because they pass not without the Skull, and *Dura Mater*, and are not afterward invested herewith, for then all the other Nerves as long as they are within the Skull, must not be called Nerves, which were absurd.

To these Nerves are adjoynd two thick portions or processes called *Processus Mammillares*, papillares: the Teat-like processes.

They are in Number, two, white, soft, broad, longish, in men thin and small, in Brutes greater, especially in Dogs, and other Creatures that have an exquisite Smell.

For, The Use of these Processes, is to be the true Organs of Smelling, and not the Nole nor its coat.

These Processes are placed in the fore-part of the Brain, behinde the Colander-bone, and to it being covered with the *Dura Meninx* they put a face. Through the Colander-bone the Odours ascend.

The Second Pare, which others count the first, is the Optick or seeing pare, because it carries the seeing Spirits to the Eyes, or the representations of visible objects to the Brain, but not humours from the Brain to the Eye to nourish it, which is the fiction of *Cesalpinius*. *Hierophilus* calls them *poros opticos* or *mentus*, the optick pores or passages, because they are thought to be hollow.

These Nerves, of all the ten pare, are the greatest, and thickest, but softer than the rest.

They arise, not as the common Opinion is, from the fore-part of the Basis of the thers about the Brain; for their original must be sought further, towards the hinder part of the tick Nervi. Head, where they are carried between the Brain, and the beginning of the spinal Marrow, and arise out of the beginning of the first Trunks of the Medulla Oblongata.

oblongata, growing out of the Brain. But *Rislanus* demonstrates, that they are turned round about those great Eminencies of the Brain, which *Galen* calls *Thalamus nervorum opticorum*, which reach unto the foremore Ventricles; that they may fetch optick spirits from thence.

The Union of the optick Nerves and the true Cause thereof.

And having proceeded a while, they are near the middle way united above the saddle of *Ossis Sphenoides*, not by a simple touch or interfection, in Mankind, but a total confusion and mingling of their Substances, that they might suffer the less, in the middle of a long passage, by reason of their softness. *Vesalius*, *Aquapendius* and *Valverde* have observed that they have sometimes continued divided, in their whole Course. *Vesalius* also observed that in a Woman they were joined only by mutual Contact, whose right Eye had been withered from a Child; because the right Nerve was smaller than the left, beyond the Conjunction. But in most bodies the inner substance of the Nerves is confounded, as I have observed by accurate Inquisition.

The growing together of the optick nerves, was therefore contrived by Nature, either lest the sensible object being received in by both Eyes should seem double, or that the Visive spirit might, if need were, be all conveyed into one Eye which are the conjectures of *Galen*, or finally for strength and stability here necessary, least in Concussions of the Brain they might hap to be broken or distorted, or least through the softness and moistness of the Brain and optick Nerves, by reason of distillations and other Excrements they might become flaggie, and so driven out of their right station; which is the opinion of *Plempius*.

Soon after being separated they go out of the Skull into the Centre of the Eyes in Mankind, but much lower in Beasts, because they look more sideways.

Within the Skull they are clothed only with the *Pia mater*; but from the holes, which pass to the Eyes, they are covered with the *dura mater*. Afterward it spreads the latter to the *Sclerotica tunica*, the former to the *Tunica choroides*, and its inner marrow substance to the *Retina*.

The third pare, which others count the second, is the *motorium oculorum*, the Eye-mover, next unto the former.

The Error of others about the Rise of the Eye-movers.

This pare is thought by vulgar Anatomists to arise from the Brain, near the original of the first pare. But it reaches to the middle of the Head, goes beneath the Opticks cross-wise, and

Why one Eye being moved, the other moves also.

Arises at the inmost part of the Beginning of the *medulla oblongata*, where in their Rise, these two motive-nerves are so united as to touch

one another, yea to become one continued Body, which is the cause, that when one Eye moves, the other is moved also.

Why sometimes when the temporal muscle is hurt, the Eye is hurt likewise.

This Pare is lesser and harder than the former and stretched out by the visive pare; goes out of the Skull at other holes to the Muscles of the Eyes and Eyelids. It sometimes though seldom sends a branch to the temporal Muscle; and that is the Cause that the said Muscle being hurt, the Eye is hurt, and the Eye being hurt that is hurt.

The Fourth, Fifth and Sixt pares are much confounded by Anatomists. For some make the fourth and fifth Pare one, and call it the third Pare, consisting of two roots; the lesser of which some do make the third pare, and they themselves do make the fifth and sixth pare one, viz, the fourth pare by them so called. But those who reckon it for one, they count the fourth pare, according to my reckoning, for the lesser root of the third pares and the sixth pare for the fourth. whereas we distinguish all these pares.

The fourth pare therefore, which others as *Bauhin* count the third; others as *Fallopian* the eighth pare; others badly, the lesser root of the third pare: for it hath nothing common with the following pare, is not joined to it, either in the Beginning or the Progress, and grows out of the order of other pares; according to some

From the side of the Beginning of the *Medulla oblongata*; according to others it grows with a very small Nerve, out of the lowest and hinder part of the *Medulla Cerebri* or marrow of the Brain: then it is carried forwards, and fastned to the second pare, it goes with it out at the common hole, enters the socket of the Eye and sends out from it self branches

Into the fat of the Eye, the fifth Muscle, and by a peculiar hole of the Bone of the Fore-head, it goes out to the Skin of the Fore-head, and the upper Eye-lid. And these are furnished by its first branch.

The second furnishes the Muscles of the upper Lip, and some of the Nose, and the Lip it self and Gums.

The third by the Cavity of the Nostrils serves the coat of the said Nostrils.

The fourth serves the inner part of the temporal Muscle. All which branches *Fallopian* doth attribute to the two following Conjugations: but my distribution is propounded by *Vesalius*, *Columbus*, *Pluvius*, and *Bauhinus*.

The fifth Pare, which others count the thicker root of the third pare; is commonly thought to furnish the Tongue with the sense of Tasting.

This arises near the following Conjugation, out of the sides of the *Medulla oblongata*, and presently after its passage through the *Ossis sphenoides*, a wisthen branch comes out like a tendrel of a Vine (which some think is done to make it harder) and is united with two little twigs of the auditory Nerve.

It furnishes the Muscles of the Face, the Temporal Muscle, the chewing Muscle of the Cheeks, the Skin of the Face, the Gums and Teeth (for by their means the Teeth have all the sense they have) the Muscle that lies concealed in the mouth and the lower Lip.

The sixth pare, which some call *Quarta conjugatio*, others the smaller root of the fourth Conjugation,

Hath a smaller Original, next the former, and somewhat harder than it.

It goes through a common hole with the former, and yet it doth not therefore become one pare with the former: for the third, fourth, and seventh pare, as I reckon them, do also pass through one and the same hole.

Whether the first pare be the same with the fifth.

It is carried into the Palate. Others would have this pare also to serve the sense of Tasting.

The seventh pare, which others count the eighth, others the ninth, others the smaller portion of the fifth pare, whereas in the mean while it is a peculiar pare smaller and harder than the fifth, also distinct therefrom in its original and progress:

For it arises a little before the fifth commonly so called, in the midst of the *Medulla oblongata*, and going over the third pare, and cutting the same, it proceeds along between the third and fourth pare, where it is carried upwards and forwards, towards the sides.

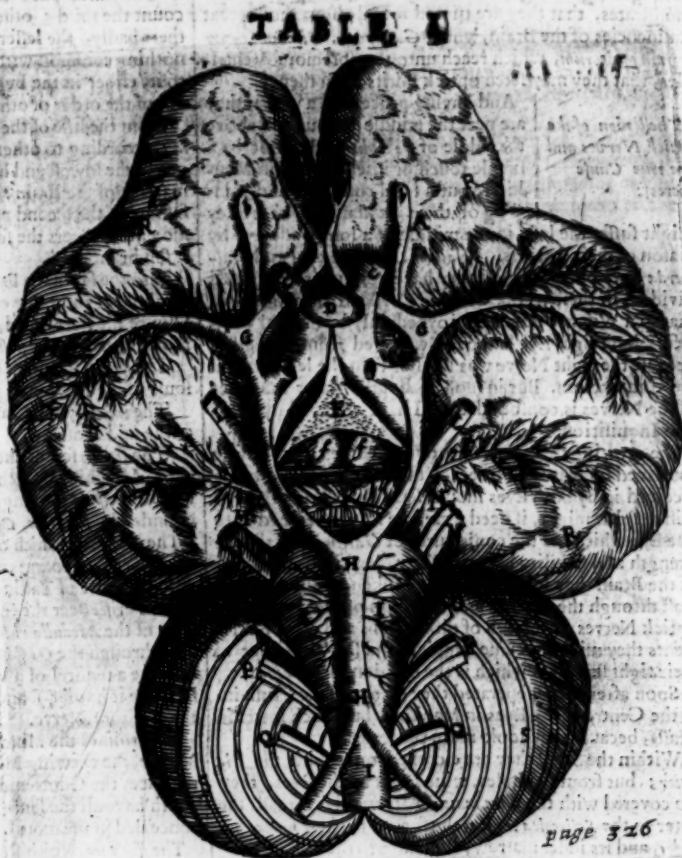
It goes out of the hole with the third and fourth pare, and is commonly quite spent upon the *Musculus abducens* of the Eye. But that is a question, which others say, that it is carried into the temporal Muscle, and into that which lies concealed in the Mouth.

The Eighth pare which others count the fifth, which is called *Auditorium*, the Hearing pare, arises close by the sides of the former, only a little below. It enters the *Orbitosum*, and is divided into the greater branch, which being spread out, they will have to make the Drum, and the lesser broad below, as if it would accompany the sixth Conjugation.

The Explication of the FIGURE.

This T A B L E presents the Original of the Nerves to be seen in the Brain turned under side upwards.

- AA. The Smelling Nerves reckoned by our Author for the first pare.
 bb. Their mammillary processes, or Tent-like productions.
 CC. The optick Nerves cut off near the Eye-holes; the second pare.
 D. The Glandula pituitaria.
 E. The Infundibulum or Funnel.
 ff. Two white kernels set before the passage of the Brain.
 GG. The greater Branch of the Carotick Artery.
 HH. The Arteria Cervicalis.
 III. The Beginning of the spinal marrow within the Skull.
 Kkk. The small branches of the Arteries, which others call the Retinabilia.
 LL. Nerves of the third pare according to our Author.
 MM. The Beginnings of the Nerves of the fifth pare.
 OO. The Nervi Auditorij, or the eighth pare.
 PP. The Beginnings of the ninth Pare.
 QQ. The Rise of the tenth Pare.
 SS. The Cerebellum or Brainlet.



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Why we cough when the Ear-picker goes far into our Ear.

It sends branches through the first and second Vertebra to the proper Muscles of the Larynx; and therefore it is that picking our Bars too deep, a dry Cough is caused. It is thought sometimes to send

branches to the Arm, with the fourth, fifth and sixth of the Arm; and sometimes into the whole Foot, with the Nerves of the Back-bone, after it hath accompanied the Spinal Marrow going downwards.

The ninth pare which others call *par sextum* and *vagus*, the first and roaming or wandering pare; because it furnishes very many parts here and there, yea and all the internal parts seated in the middle and lower Bellies, which receive branches for sense, seeing they are soft bodies, nor can away with the harder sort of Nerves springing from the spinal Marrow. And because of the long way they go, they are clothed with strong Membranes, and are carried united to the neighboring parts.

This Pare arises a little beneath the foregoing, sundry fibres being presently united.

It goes out through the hole of the Occiput, through which the *Ramus major jugularis interna* had ascended: and not far from its egress it provides for the Muscles seated in the Neck, especially the *Cuticularis*. Then the Trunk descends, and is knit with the last pare, the Carotick Artery, and Jugular Vein; and sends branches athwart, through the Membrane and Muscles of the Larynx, also the Muscles of the Hyoides and the Fauces, as also to the Tongue.

Then descending between the Carotick and Jugularis, to the side of the Wefand above the Jugulum, it is divided on each side into the exterior and interior branch.

The Exterior constitutes the *recurrent* Nerves, or vocal Nerves so called, because they being wounded the living Creature looses its voyce; so that if one be cut asunder, half the Voyce is lost; if both, the animal becomes dumbe. they are also termed *reversivi* or *recursivi*, running-back; for first they descend, and they turn afterwards back again as it were about an Axle-tree on each side, the right about the *Arteria axillaris*, the left about the descending Trunk of the Artery; and afterward they ascend as high as the Muscles of the Larynx, to which they give numerous branches, which recursion was to be made, because the Muscles of the Larynx have their Heads, not above but beneath.

And therefore the Exterior dexter of the sixth pare, presently after the division, furnishes the Muscles arising from the Breast-bone and Clavicula; then the right Recurrent being constituted for the most part of three little twigs bended back and united, it descends obliquely under the Jugulum, and in its passage shoots out little branches for the Coat of the Lungs, the Pleura, the Pericardium and the Heart; and then makes the right stomachic, under the Gullet joyned to the left; and passing through the Septum, it goes into the right Ventricle of the Stomach to the left branch. The

The *Exterior Sinister*, furnishing the Parts in the same manner as the former, and constituting the left Recurrent, it sends forth the *Stomachicus sinister*, which with its fellow compasses the orifice of the Stomach and the remainder goes to the Pylorus and hollow of the Liver.

The *Interior dexter* first of all gives a Branch of it self, at the roots of the ribs, to every intercostal Nerve; and then with the great Arterie it passes through the Septum, and furnishes the whole lower Belly, till it reach as far as to the Os Sacrum. And then it goes into three Branches.

How Hoarseness comes after the Cholick.

I. Goes to the Call, from whence arise other three twigs, 1 To the Colon, hence after a long Colick comes hoarseness. 2 the smallest scarcely visible, to the beginning of the Guts. 3 To the

right side of the Bottom of the Stomach, the upper Membrane of the Call, the Coat of the Liver, and the Gall-Bladder.

II. The *inferior* to the right Kidney. Hence they assigne the cause of Vomiting, in fits of the Stone in the Kidney. *Why Vomiting in the Stone of the Kidney.*

III. The *greatest* to the Mesentery, Guts, and right side of the Bladder.

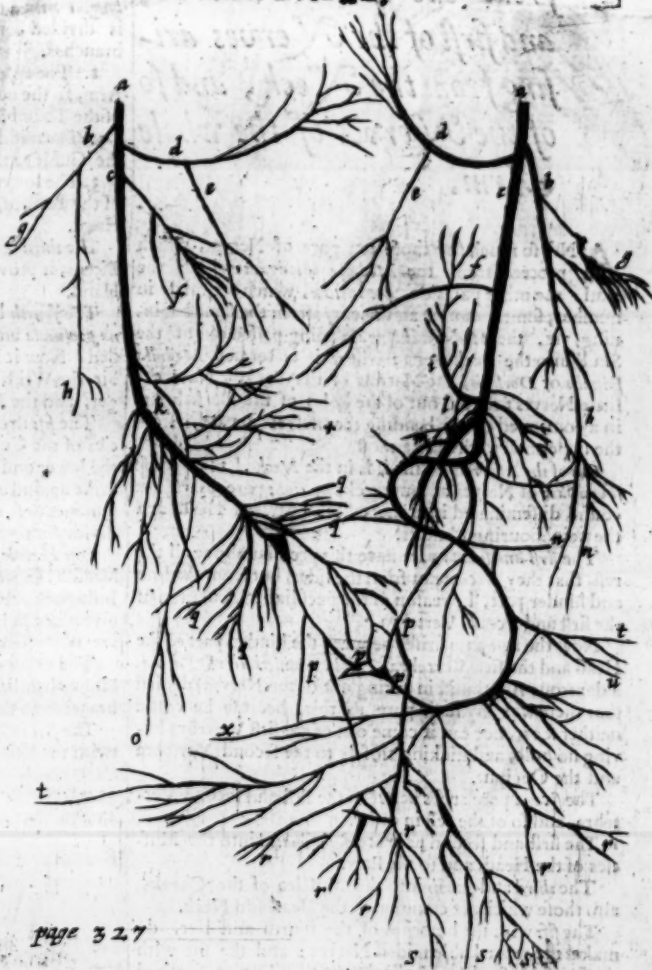
The *Interior sinister* in its side is distributed after the same manner, save that in stead of the Liver part thereof goes unto the Spleen. But from both the interiors, sometimes Branches are sent unto the Womb.

This is the distribution of the sixth Pare according to the vulgar computation, the Ninth according to my account.

The FIGURE Explained-

This TABLE presents the lower Branchings of the sixth pare of Nerves, which our Author calls the Ninth others the wandering or roaming pare.

The II. TABLE.



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- aa. The coming of the said Nerves out of the Skull.
- bb. The Ramus externus on both sides.
- cc. The Ramus internus on both sides.
- dd. A remarkable Branch spread into the Tongue.
- ee. A Branch arising from the same on each side, which goes to the Muscles of the Larynx.
- ff. Another twig which goes with the former to the Larynx.
- gg. Twigs arising from the external Branch, and propagated to the Muscles of the Neck.
- hh. The conjunction externi Rami singularis, with Nerves which arise from the plexus of the Neck.
- ii. The recurrent Nerve on each side.
- k. The more internal Branch arising near the first Rib of the Chest, which bestows the twig thus X marked upon the Trunk of the Wessel, and then descending ends into the Pericardium or Heart-bag.
- l. A little Branch arising from the recurrent, which descending producesh another twig out of it self, and goes into the pericardium, and as last it implanted into the external Branch.
- m. The twig arising, as was said, from the same, and diffused into the pericardium.
- nn. Two twigs arising from the external Branch, the one of which is implanted into the Substance of the Heart, and the other tends to the Beginnings of the Vessels.
- o. The aforesaid Branch implanted into the pericardium.
- pppp. The Plexus or conixture of both Branches, viz. of the rights and left, about the Gall, near the upper Orifice of the Stomach.
- qqqq. Twigs spread abroad into the Lungs.
- rrrr. Branches propagated into the upper parts, especially of the Stomach.
- ssss. Four remarkable Branches, which descending into the Mesentery, are spread abroad to the guts.
- tt. The right and left Nerve-twig of the Kidneyes.
- u. The Nerve-twig of the Spleen.
- x. The Nerve of the Liver.

The *seventh* and *last* pare of Nerves, arising within the Skul in the hind part of the Head, out of the Medulla oblongata when in is ready to slide into the Back bone, is as others reckon the seventh pare.

This is *harder* then the rest, and it springs from divers roots afterwards united, and goes out of the Skul at a crooked hole proper to it self. And soon after it is with strong *membranes* joyned, not mixed with the precedent pare, for safe-guard sake. And then it is separated again, and goes the greatest part of it into the tongue, and some small part into the Muscles of *Os hyoides* and the Larynx.

CHAP. III.

Of the Nerves which proceed from the spinal Marrow, and first of the Nerves arising from the Neck, and so of the Nerves of the whole Arm.

AND so much for those ten pare of Nerves, which proceed from the Medulla oblongata within the skul: the other pares do now follow, which are thirty in number, sometimes nine and twenty, from the same beginning, viz. the Medulla oblongata being passed out of the Skul into the Back bone: where it is termed Medulla spinalis or Dorsalis, the Marrow of the Back. Now the little Nerves proceed out of the holes of the Back bone, in a continued course bending themselves inward, from the uppermost to the lowermost.

Out of the Marrow, while it is in the Neck, there arise seven pare of Nerves as some reckon, eight pare as others count, disseminated into the whole outward Head and the neighbouring Muscles.

The first and second pare have this peculiar above all the rest, that they proceed not from the sides, but from the fore and hinder part, by reason of the peculiar Articulation of the first and second Vertebra.

Now the first pare arises between the hinder-part of the Head and the first Vertebra. *Joh. Leonicensius* of Padua, a dextrous Anatomist in taking out of the Nerves, denied that there was any such pare as this, because he could neither see it, nor can it come out of the first Vertebra having no hole, and sticking closely to the second Vertebra and the Occiput.

The second pare arises between the first and second Vertebra, and so of the rest in order.

The first and second pare are disseminated into the Muscles of the Head, and to the Ears.

The third and fourth into the Muscles of the Cheeks, also those which are common to the Head and Neck.

The fifth with the branches of the fourth and sixth, do make the remarkable midriff Nerves: and the sixth with the foresaid, sends a part backwards, and a part forward into the Muscles bowing the Head; those of the Arms, Shoulderblades, and the Skin there.

The sixth to the Arms and the hollow of the Shoulderblades.

The seventh is joyned with two of its Neighbours, viz. the sixth of the Neck and first of the Chest, whose greatest part goes to the Arms and as far as the Hands.

For there are carried into the Arms five or six pare of Nerves, viz. from the fifth, sixth, and seventh pares of the Neck, also from the first and second pares of the

Chest, which when they first break forth, they are all mixed and united, nor are separated without damage, and soon after they are severally divided into the foresaid Pares; to the End haply, that by that light concurrence, a collection might be made of animal spirits. Hence To-pick Medicaments, in a Palsie, or Convulsion of the Arm, the upper part of the Arm being affected must be applied on the side of the upper part of the Back and the Neck, from whence the Nerves proceed, not directly in the middle, either of the Back or Neck, unless by reason of the common beginning of the Nerves.

The first Pare, from the first pare of the Neck, goes chiefly into the Deltoides Muscle, and the Skin of the Arm, leaving a part which accompanies the Vena humeraria.

The Nerves of the whole Arm.

The second being thicker, is carried through the Middle and Forepart of the Cubit, where it furnishes the Musculus biceps, whereupon it is joyned with the third Nerve, and afterwards going downwards, it salutes the Supinator longior with a twig: but at the bending of the Cubit, it is divided sometimes into Two, otherwhites into three branches.

1. The upper and lesser, goes along the outside of the Arm, to the outer part of the first or second Interjuncture of the Thumb.

2. The middle and thicker descends obliquely within the Cubit to the Wrist.

3. The lower, being stretched along by the inner branch of the Basilica, is spent into the Skin of the Cubit and Hand.

The third is joyned with the former, under the Muscle Biceps, it provides for the Brachialis and the inside of the Hand.

The fourth being the thickest, goes along with the Vena profunda and the Artery, Afterwards is variously divided. Now it furnishes the Muscles which extend the Cubit, the Wrist, the Thumb, the fore and the middle Finger, and the Muscles which stretch the Fingers out.

The fifth stretch along by the former, between the Muscles of the Cubit, which it furnishes descending through the lower and hinder part of the Cubit (where when we strike against any thing or compress the Nerve, we feel a nummedness in our fingers) in the middle thereof it is divided into two.

One branch goes externally through the Ulna to the Middle Finger, Ring-finger, and little Finger. On the Inside of the Fingers for securities sake, that they may give place in laying hold of any thing, for there Wounds are more pernicious than in the middle.

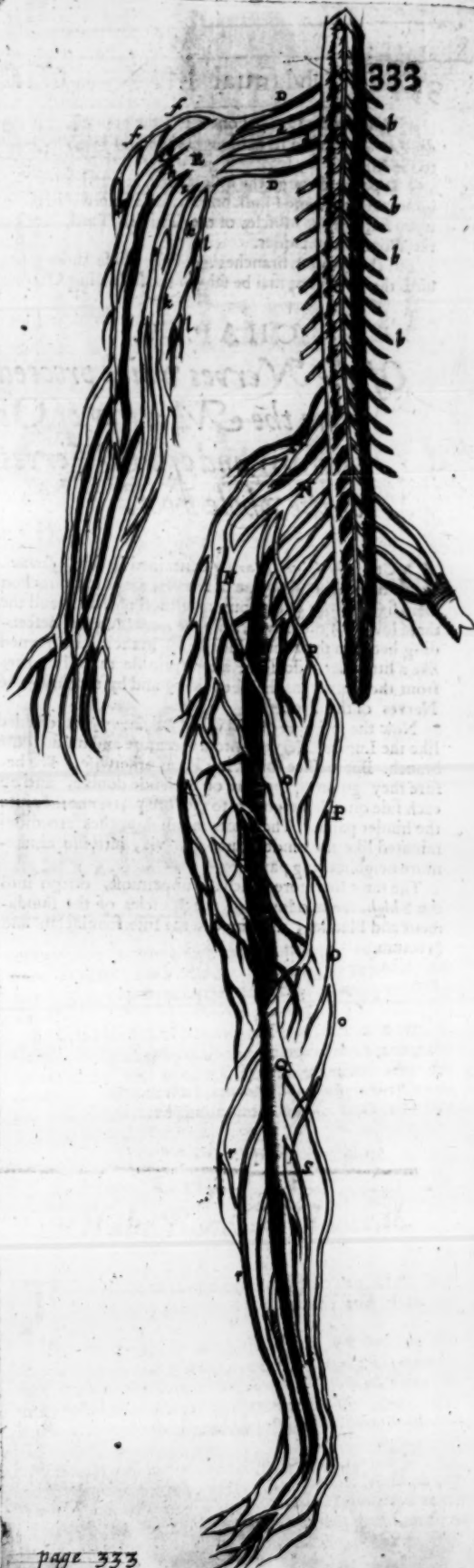
The other goes inwardly through the Ulna betwixt the Finger-bending Muscles as far as the Wrist, and sends branches to the same parts as the former sent to.

The sixth is spent into the Skin of the Cubit, going betwixt the Skin and the Membrane.

The FIGURE Explained.

This FIGURE presents the spinal Marrow and the Nerves derived therefrom to the Limbs,

- A. The beginning of the spinal Marrow near the Skull.
 bbb. The Boughs orderly propagated from the Medulla.
 ecc. The Body is self of the Marrow, half included within the Vertebrae, above which little Veins and Arteries spread themselves.
 DDdd. Branches arising from three pairs of Nerves of the Neck, and two of the Chest, to be distributed into the Hand.
 E. The Connixture and Commixion of those Nerves.
 ff. The first pair of Nerves of the Hands.
 gg. The second Pair.
 hh. The third Pair.
 ii. The fourth Pair bigger than the rest.
 kk. The fifth pair.
 ll. The sixth pair which is under the Skin.
 M. The first Nerve of the Thigh.
 N. The second Nerve.
 ooo. The branch of the second Nerve which accompanies the Saphena.
 PP. The third Nerve of the Thigh.
 QQQ. The fourth Nerve of the Thigh, thickest of all.
 rr. The Ramus externus.
 ss. The Ramus internus.



CHAP. IV. Of the Nerves of the Chest, the Back and Loyns.

From the Marrow of the Back arise *twelve pairs*, or as some reckon eleven all and every of which after their Egress are divided into the greater and lesser branches: the one of which is carried forward, the other backward, being bowed backwards.

The *foremore* branches, are sent into all the Intercoastal spaces, the internal and external ones (both which I have sometimes seen divided into two branches) for the Muscles which lie upon the Chest, also for the oblique descendent of the Belly.

The *hindmore* and lesser branches go backwards to the spines of the Back, betwixt the Muscles which grow to the Vertebrae, into which they are partly consumed, and partly into those which grow from these points of the Spines, as into the *Rhomboides, Cucularis, &c.*

Out of the spinal Marrow when it is in the Vertebrae of the Loyns, there arise sometimes *five*, sometimes *four* pairs of Nerves: which pairs are greater than those of the Back. And each of these is divided into the foremore and hinder branches, which are disseminated, partly into the Muscles of the Loyns and Hypogastrium, and partly into the Thighes. For

1. This Pair gives a branch to the fleshy parts of the Midriff; and then provides for the Muscles of the Belly and Loyns.

2. It affords branches to some of the Muscles of the Thigh and Leg, and as many suppose, a branch to the Spermatick Vessels.

3. It goes to the Knee and its Skin, and part accompanies the Saphena, and part goes to the Muscles which rest upon the Loyns.

H h h

4. Among

4. Among the Lumbal ones, it is the greatest, proceeding to the four Muscles of the Thigh and Leg, as far as to the Knee.

5. It passes through the hole, which is betwixt the Hip-bones the Share and Flank bones, and bestows branches upon some of the Muscles of the Thigh, Yard, neck of the Womb and Bladder.

But the greatest branches go from these three parts, unto the Thighs as shal be said in the following Chapter.

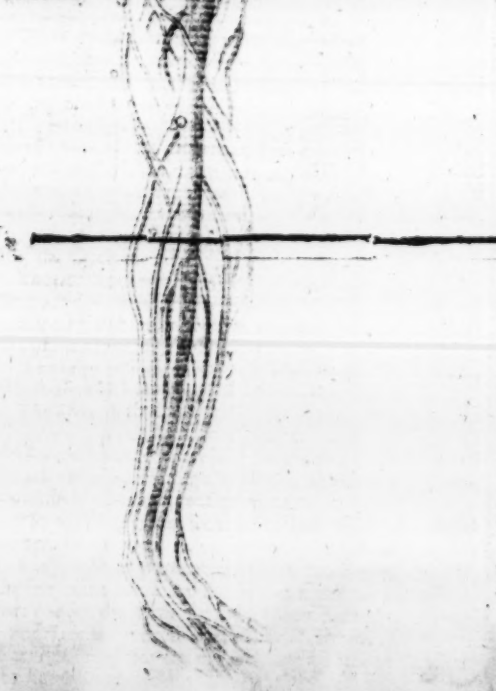
CHAP. V.

Of the Nerves which proceed from the Marrow of Os Sacrum, and of the Nerves of the whole Foot.

OUT of the spinal Marrow contained in the Os sacrum, there arises five pare of Nerves, or as some reckon their six pare, out of the four uppermost of which, and the three lower of the Os sacrum, arise the *crural Nerves*, descending between the Feet, which being in their Rise joyned like a little Net, do soon after sprinkle three branches from themselves, as shall be said by and by touching the Nerves of the Feet.

Now the first pare of Nerves of Os sacrum, is divided like the Lumbal Nerves, into a foremore and hindermore branch. But the five following Pares otherwise. For before they go out, they are on each side double, and on each side one Nerve goes into the fore parts, another into the hinder parts. The hindermore branches are disseminated like the hinder Lumbals, viz, into the hindermore neighbouring parts.

The three foremore which are uppermost, do go into the Thigh, the two lower to the Muscles of the Fundament and Bladder; and some to the Interfemineum and Scrotum.



Moreover, the end of the Marrow of the Back, doth produce only one branch out of it self which is therefore termed *Sine pari*, without a Mate or fellow; yet sometimes it hath a fellow. It spends it self into the Skin, between the Buttocks and the Fundament, and into certain Muscles of the Thigh.

Now follow the Nerve which go into the Thigh, which before were said to be four in number.

The first and third are shorter, and reach only to the Thigh, the second is longer, and goes also to the Leg, the fourth is longest of all.

The first being made up of the third and fourth pares of the Loyns, descending to the small Trochanter, spends it self into the Skin and Muscles of the Thigh, and some of the Leg, and is ended above the Knee.

The second arising from the same place, descends with the Vein and Artery to the Thigh through the Groyns, it goes to the foremore Muscles of the Thigh, and is spread about the Knee. But it sends a remarkable branch inwardly with the Saphæna to the Ankle.

The third arises in the Articulation of the fourth and fifth Vertebra, passes through the hole of Os pubis, to some upper Muscles of the Thigh and Yard, arising out of the Os pubis; and to the Skin of the Thigh in the Groyn.

The fourth is the thickest, longest, hardest and driest in the whole body, made up of four pare of the Os sacrum; it furnishes the Skin of the Thigh, and certain Muscles thereof, as also of the Leg and Foot. I have sometimes observed this to have a double rise, and a double progress, the one External the other Internal.

But that same great Trunk under the Ham, is divided into an external and an internal Branch.

The external goes to the Ham, the outside of the Foot, the Musculi peronei, and the outer Ankle.

The Internal and greater goes along the Leg to the Muscles of the Feet and Toes; the inner Ankle, the great Toe and sole of the Foot: and bestows two twigs upon each Toe.

All the Nerves therefore well-seer, which go into the whole Leg and Foot, do arise from the only greatest crural Nerve.

THE NERVE OF THE FOOT, which is the fourth of the five that arise from the Os sacrum, is the thickest, longest, hardest and driest in the whole body. It is made up of four pairs of the Os sacrum, and it furnishes the skin of the thigh, and certain muscles thereof, as also of the leg and foot. I have sometimes observed this to have a double rise, and a double progress, the one external the other internal. But that same great trunk under the ham, is divided into an external and an internal branch. The external goes to the ham, the outside of the foot, the musculi peronei, and the outer ankle. The internal and greater goes along the leg to the muscles of the feet and toes; the inner ankle, the great toe and sole of the foot: and bestows two twigs upon each toe. All the nerves therefore well-seer, which go into the whole leg and foot, do arise from the only greatest crural nerve.

THE



THE
Fourth and last Manual
OF
THE BONES
And also of the
Griftles and Ligaments
Answering the
FOURTH BOOK
Of the Limbs.

*The reason of
the Authors
Method.
Why he treats
last of the
Bones.*

IN the last place, I shall briefly (as I have done other things) explain the Doctrine of the Bones.

In the last place, I say, because when all things else are removed and separated, then only the Bones come in view, and are subject to examination. The most dili-

gent *Riolanus* treats in two places of his *Enchiridion*, of the Bones, once as they appear in the dead Carcas, when the Muscles are cut off, and again as they are dried in a Skeleton. But this Ostentation is superfluous in a compendium. For by the same reason we should make a new Anatomical discourse, of the Veins, Arteries, Nerves, Guts, Stomach, Womb, and other Parts taken out, and dried, and commonly hung up for shew in the Anatomical Theatres. There is no use of the latter Doctrine of the Bones, unless to help the Memory, nor is it perfectly understood without the former. And therefore other Anatomists, with the parts demonstrate the Bones lying beneath them, in the dead body. I shal therefore only busie my self with the first, and therewith.

Joyn the Doctrine of *Griftles* and *Ligaments*.

*Why he treats of
the Griftles and
Ligaments with
the Bones.*

1. Because of the similitude of their substance: for these three funilar parts are very near of kin, A Bone, a Gristle, and a Ligament, so that they seem to differ only gradually in respect of more and less one from another.

For a Bone is the hardest, a Gristle, a little softer, yet so as that it may turn to a Bone, as we see in the tender Bones of Infants, which at first were gristly. A Ligament is yet

softer than a Gristle, which also it self sometimes turns to a Bone, as in decrepit Persons. Hence many attribute the same matter to a Bone, a Gristle, a Ligament, yea and a Tendon.

2. Because of the Nearness of Place; for a Bone, a Gristle, and a Ligament do for the most part accompany one another, and are found joyned together. For the Bones are tied with the Ligaments, and where they are tied, they are covered about their Heads, with a Gristly Cruft or Cover.

CHAP. I.
Of the Bones in General.

THE Nature of the Bones is easily known, if we shal but orderly propound their Causes and Accidents or Adjuncts.

The Matter out of which the Bones are bred in the Womb, according to *Hippocrates*, is an earthy Excrement, with Far and Moisture added thereto. *Aristotle* also calls it *Excrementum seminale*, an excrement of the Seed. *Galen* saies it is the thicker and harder part of the Seed dried.

Now some Bones are perfectly generated in the Womb, as those in the Ear which serve the Sense of Hearing, being the smallest in the whole body; others imperfectly, as the Teeth and all the rest of the Bones, in which at first somewhat is wanting, either a process, or an Appendix. &c.

Moreover

Moreover, all other Bones save the Teeth have a certain determination of their growth : but the Teeth grow continually, for if one Tooth be removed, that just against it grows longer : which Nature therefore ordained, because they are always wearing through grinding and chewing the Meat.

Whether the Marrow be the Nuriment of the Bones.

Their remote nutritive Matter, is thought to be the thicker and more earthy part of the Blood, and that which is as it were excrementitious, flowing in through the Veins into the Marrow, where in the Cavities of the Bones it may be digested, for

Platerus denies that the Bones have Arteries, wherein Spigelius contradicts him : if there be Veins, there will doubtless be Arteries, which are as inconspicuous to the sight as the Veins are. Hence it is, that in the Cavities of the Bones of Animals newly brought forth, the Marrow is as yet bloody.

The Immediate nutritive Matter of the hollowed Bones, according to Hippocrates and Galen, is the Marrow contained in the said Bones (who are contradicted by Aristotle and other Peripateticks, who will have the Marrow to be rather the excrement of the Bones) as in Gristles that same snotty matter which lies round about them, is their immediate nutritive Matter ; and in Ligaments, Membranes and Nerves, that same clammy humor shed in amongst them.

Of the solid Bones not hollowed, the immediate Nutritive matter, is thick Blood sent in through the pores ; because 1. Being broken they are joyned with a Callus, bred of the Remainders of the alimentary Blood. 2. They are liable to Impothumation in their Substance, the superfluities of the nourishment putrifying in the pores. Hofman allows that they are nourished with Blood contained in the Marrow, and that the Marrow serves the Blood, by carrying the solid part.

The *Efficiens* is the *Vis ossificæ*, or Bone-making faculty, or the innate faculty, acting by the Assistance of Heat.

The *Form* of a Bone is the Soul, as of the whole, and in the next place the *ratio formalis* whereby a Bone is a Bone and no other thing, 2. *de Gen. Anim. cap. 1.* And therefore the Bones of dead persons are not properly but equivocally Bones. The Accidents or Adjuncts of Bones, are their sundry Figures, Solidity, Strength, &c. of which hereafter.

The End or Use of the Bones, is,

1. To be the Foundations and Supporters of the whole Body, like Pillars or Foundations in Houses.
2. To be as a Safeguard for some parts, as the Skull safeguards the Brain.

Why creeping things cannot go.

3. To serve for going, as is apparent in the Thighes and Legs. and therefore Serpents, Worms and other Creepers, which have no Legs; cannot go, but are forced to crawl.

4. There are some private uses of divers Bones, of which in the special History of Bones.

5. Certain Medicinal Uses there are of Bones. Their Pouder cures a Cancer, Fevers, any Fluxes. Their Oyl is good for the Gout, the Magistery of a Mans Skull is good against the Falling-sickness, as also the triangular Bones of the Occiput, &c.

The Situation of the Bones is deep, because they are the Foundations and Upholders of the Body.

They vary in Magnitude according to the variety of their Utilities. Great are the Bones of the Leg, Thigh, Arm, Shoulder, &c. Small those of the Ear serving for Hearing, the Sesamoidean Bones, the Teeth, the Wrist-bones, &c.

Why many Bones in a living Creature.

They are many in number and not one only, because of the variety of motions ; and lest that one being hurt, all should be hurt.

Now a monstrous thing it is for a Child to be born

without Bones, such an one as Hippocrates speaks of, being a Boy, four fingers big, but not long-liv'd the like to which *Forester* also saw.

The Number of all the Bones of the Body, is not the same in all Persons. For in Children they are more, which by degrees grow together and become fewer. Others may number the Epiphysis by themselves as distinct Bones, and so make a mighty number. Others may omit the Sesamoidean and other small Bones, or such as are seldom found, as in the Carotick Arteries : and so doth *Archangelus* who reckons but two hundred forty nine : others make commonly three hundred and four. Others as many as there are daies in the year.

They vary in Figure some are round, others flat, some sharp, others blunt, &c. as shal be shewed when we come to speak severally of the particulars.

The Colour in such as are naturally constituted, is white, mixt with a very little red.

They are all of them externally inclosed (not internally) with the Periostium, excepting the Teeth, sesamoidean Bones, and the fides of the other Bones where they are mutually joyned one to another.

And the Periostium is exquisitely sensible : but the Bones themselves want the sense of Feeling, excepting the Teeth, to whom we may attribute some Sense, seeing they feel exceeding cold Air or Water, yea with their Ends : especially

The Periostium feels, but not the Bones
The Sense of the Teeth.

when the Teeth are on Edge, before it reach to the little Membranes and Nerves, by help whereof they are thought to Feel.

The Connexion of the Bones is various. But the mutual and artificial hanging together of all the Bones is by the Greeks call'd Skeleton, as if you would say a dried Carcass from *skellein* to drie. Being compacted partly with the natural Ligaments dried with the Bones, & partly with artificial ones, sometimes bolt upright, otherwhiles in the posture of sitting ; which doth not properly belong to Anatomy, but the other Natural Osteology, framed by Nature, and adorned with its own moist Ligaments.

And this natural Coherence or Connexion, according to Galen, is made either *Cartilaginea* by way of Joyning ; or *Cartilaginea*, by way of growing together.

He makes *Arthron* a Joynt to be double ; viz. *Diarthrosis* or by way of Diarticulation or joyning, such as are *Enarthrosis*, *Arthrodia* and *Gigglumas* : or *Synarthrosis*, such as he reckons *Suture*, *Harmonie* and *Gomphosis*. Moreover *Symphysis* or growing together, is said to be with or without a Medium.

But I shall thus divide the Connexions of the Bones.

The Bones are fastned together either by *Articulation* or Joyning ; or by *Symphysis* or growing together.

Articulation or *Joyning* is with motion, and that either *obscure* (which others call neuter or doubtful Articulation) as that of the Ribs with the Vertebrae, also of the Bones of the Wrist and Pedium ; or *evident* loose and manifest, and it is called

Diarthrosis, of which there are three sorts :

I. *Enarthrosis* Inarticulation, which is when there is a great quantity both of the Cavity of the Bone receiving, and of the Head of the Bone which is received : as in the Articulation of the Thigh with the Huckle-bone.

II. *Arthrodia*, is where the Cavity receiving is superficial, and the Head received flat : as is that of the lower Jaw with the Bone of the Temples.

III. *Gigglumas*, when the same Bone both receives, so that contiguous bones do mutually enter one into another. And it is done three manner of waies :

1. When the same bone is received by one bone which receives the same again mutually ; as we see in the Articulation of the Shoulder-bone with the Cubit.

2. When one bone receives and is received of another, as in the Vertebrae. For the Vertebra being placed in the middle, receives the upper and is received by the lower.

3. In

3. In manner of a wheel, as that of the second Vertebra of the Neck with the first; where upon the Axel-tree as it were of one Vertebra, another is turned and wheeled about,

By *Symphysis* or growing together, Bones are fastned, when the Connexion is without motion, and two Bones do only touch one another, or approach mutually one to another, as in the former.

And this growing together is either without a medium or with it.

Without a Medium:

1. *Rhaphé* a Suture as in the Skul.

2. *Harmonia*, which is a joyning of Bones by a single Line, streight, oblique, or circular: as in bones of the upper Jaw and the Nose. And so all Epiphyses in a manner are joyned.

3. *Gomphosis* that is to say Nailing, when one Bone is fastned into another as a Nail in a Post, as the Teeth in the Jaw-bones.

These three sorts *Galen* and others following him, have comprehended under *Synarthrosis* as the Genus or kind. But they are out: because Bones thus joyned have no motion, yet peradventure they may some waies pertain to *Synarthrosis*, because of the firmness they afford to the parts of the body.

With a Medium there is also a threefold growing together of the Bones, by reason of a threefold body coming between as the Medium:

1. A *Gristle* and the conjunction is called *Symphondrosis*, as in the Bones of the lower Jaw, and the Share-bones.

2. A *Ligament* and it is termed *Synneurosis*, as is seen in the Union of the Huckle-bone with the Thigh-bone.

3. *Flesh* or a Muscle, and it is called *Sussarcosis*, as in the *Chyloides* with the *Scapula*.

The Substance of the Bones is hard, but not with driness in an healthy State, but with a shining fattiness, to which others joyn an acid or sharp spirit and a volatile Salt, in which regard they easily take fire and are burnt instead of Wood, as the *Rogus* of the Romans or their Funeral-fires did witness [and our English

A Bonafire properly what.

Bonafires, for anciently (and yet in the North) they kept their Bones of Beef &c. til an occasion of Triumph, and then brought them out for joy to make Bone-fires] otherwise they would easily be broken, as we see in calcined Bones, and in that old Woman, whose Members would break at the least touch, as *Nic. Fontanus* relates in his Observations. And *Galen* tels of some bones that would turn to Sand and Dust, like rotten wood, which is the effect of driness.

The Less this *Hardness* of the Bones is, the better do broken bones grow together and unite.

But in Persons that are come to years, they do not truly grow together, nor are regenerated, but are as it were glewed together, by the coming between of another substance like Glus, which they term *Callus*. *Galen* calls it *Porus*. Now a *Callus* sometimes happens beside the Intent of Nature, through overgreat plenty of Aliment and bad Nutrition: viz. when by a boney callus, the three upper Vertebra's of the Neck are so glewed together as they seem to be but one bone: or when the first Vertebra is glewed to the Skul; and such persons cannot express their consent or dissent, by moving their Head forwards or backwards as the manner is.

There is a greater hardness in some Bones than in others, as the Thigh, &c. But other Bones are softer, as of the *Os Spongiosum*, the last bones of the Fingers &c. *Fernelius*, *Ruellius*, *Hollerius* have found all the bones so preternaturally soft, that they might be bowed like Wax, and that chiefly by the venereal Pox, witness *M. Donatus*. The *Cartilago iuxtaformis* proves sometimes so soft and flaggie, that it falls, of which see *Codronchius*.

The parts of the Bones are solid or Hollow, yet *Plinius*

tels us, that there were some that lived whose bones were solid, without any hollowness, who are by him called *Cornei*, and that such persons are known, in that they never sweat nor thirst, which *Salinus* avouches of one *Lyddanus* a Syracusan. But both these Authors can sometimes drop leadings.

The Cavities are either within where the Marrow is, which cavities nevertheless are not every where conspicuous; or without at the joynings; which hollownesses if they are deep, they are called *Cotylai* or *Cotylides* (not *comledones*) also *Acetabula*, Sawcers. *Cotyle* was among the Ancients, a measure of Liqueurs, containing as much as their *Flemius*; also a kind of Drinking Cup, as some suppose. If the Cavities are shallow, they are called *Glenoides* and *Glenoidides*, from the form of the Eyes hollowness when the Eye-lids are shut.

The solid parts of the Bones are three.

The first and principal is called *Oss*, and is the hardest part, seated commonly in the middle.

The second is by the Greeks called *Apophysis*, also they term it *Propolen* and *Ephphesin* &c. the Latines call it *Processus*, *Productio*, *Projectura*, *Exuberantia* &c. It is a part of a bone, not only touching as *Epiphysis*, but continued bunching out beyond the plain surface of the Bone: such as many are in the Vertebra's of the Back, also in the lower Jaw-bone.

Its chief use is for the original and Inferiion of parts, as Muscles.

The third is *Epiphysis*, or *Appendix*, *Adnascencia*, *Ad-disamentum*; being a bone growing upon a bone, by a simple and immediate Contact, though not with so very plain a Surface, but a little mutual Ingrefs of Heads and Hollows, like *Ginglunus*, though without motion.

The Substance of the *Epiphysis* is rare and loose, being at first for the most part gristly; but in persons grown to years, it is hardened, and turns to a bone: yea in elderly persons, the *Epiphysis* is so united to the bone, as if they were but one continued bone.

At the Ends of the *Epiphysis* a *Gristle* is placed.

But all Bones have not these *Epiphyses* growing to them: yet there are divers of them; as in the *Scapula*, on the Bones of the *Tibia* and the *Fibula*, viz. on each side, at the Tree and Foot &c. Also the Tooth of the second Vertebra, the *Rotator magnus*, the *Appendices Scyloides*, are *Epiphyses*.

The Use of *Epiphyses*.

1. In soft bones they are instead of covers, that the Marrow may not run out.

2. They serve for firmness, for that Basis is most firm which is broadest and largest.

3. That from them Ligaments may arise.

4. According to *Pavins*, that they might be as it were an intermediate matter, to be inserted betwixt a bone and Ligaments, as the Membranes betwixt the Brain and Skull.

The *Apophysis* are in some places called *Capita* Heads; in other places, *Cervices* Necks; in other places *Tubercula* bunches; in some place *Spina* thorns; in other places *Mucrones* sharp points. But the parts which at the round of the Cavities, stick out and hang over like Lips, are called *Superilia* Brows, and *Labra* Lips.

Chap. II. Of Gristles in General.

Gristles next to Bones are the hardest similar parts; and almost just of the same Nature with Bones, for such Beasts as have no Bones, have Gristles instead of Bones according to *Aristotle*.

But they differ, because they are softer than Bones, though harder than Ligaments: and though very many Gristles are in process of time turn'd into Bones [as *Carni*

den shews by the example of a Thief of *Milaine*, whose weland was become boney. Also many Sceletons of my Kinsman *Henry Faires* declare, that the Cartilago scutiformis, or shield-fashion'd Gristle, is changed into the hard substance of a Bone, which I also have observed in Dissections; yet all Gristles are not so, as the Ensisformis, that of the Share, of the Spines of the Back, of the Nostrils and Ears: which nevertheless sometime, in aged persons are turned into Bones. Moreover a Gristle hath no Marrow, no Cavities nor Caverns.

The *Efficient* is the Gristle-making power or faculty.

The *Matter* according to *Aristotle* is the same with that of the Bones, from which he will have them to differ only gradually. According to *Galen* it is an earthy but withall moist part of the Seed, partly clammy and glewily, partly fat: but more clammy than fat.

Its *Use* 1. Is principally to render motion more easie and lasting in the Joynts, while it anoynts the parts of the Bones, least by mutual rubbing one against another, they should wear and fier. Hence in some Joynts are found Gristles which crust over two bones joynted together.

2. To defend the parts from external injuries. For they are not easily bruised and broken, because they are hard and not friable, nor are they easily cut and squeezed as the soft and fleshy parts. Hence the extrem parts of the Nose are gristly. Hence Gristles are joynted to the Breast-bone and Ribs, to defend the Heart and Lungs, and the Gristle *Ensisformis*, to defend the Midriff and the mouth of the Stomach.

3. To make such a Connexion of the Bones as is termed *Synchondrosi*.

4. To shape parts prominent or hollow; as appears in the Ears, Larynx and Weland.

5. To fill up hollowneses, especially in the Joynts, as is seen in the Knee.

6. To serve for a cover, as in the *Epiglottis*.

7. To be as an underpropper to sustain somewhat, as the Gristles of the Eyelids bear the Hairs.

Their *Situation* is various, for Gristles are found in sundry parts, in the Eye-lids, Nose, Ear, Larynx, Weland, Spine, Chest, Ear-lets, of all and every of which in their places.

Their *Magnitude* also varies: so also

Their *Figure* is divers, as ring-fashion'd, Shield-shap'd, Sword-like, &c.

As to their *Connexion*. Some Gristles constitute parts of themselves, as that of the Nose, *Xyphoidis*, the *Coccyx*: others grow to bones, which knit them together, either without any other medium, as in the Share and Breast-bones, or by common Ligaments coming between, as in the Connexion by *Diarthrosi*.

In *Substance*, some are harder, as those which in time become boney; others are softer, fastning the Joynts, and resembling the Nature in a manner of Ligaments, and are therefore called *Chondro-syndusmoi*, Gristly Ligaments.

Now though their Substance be hard, yet it is flexible and tough because less cold and dry than a bone, and because compassed with a storty matter.

And this Substance of theirs is void of sense; because it hath no acquaintance with Nerves nor Membranes. Nor was it requisite that it should feel, least in motion when the Gristles rub and strike one against another, pain should be caused.

In other things they agree with Bones.

Chap. III. Of Ligaments in General.

Ligamentum a Band or Tie, is by the Greeks called *Shndemos*. The Ancients, as *Hippocrates*, *Aristotle* and *Galen* somewhere, call it *Nervum* and *Nervum colligamentum*.

turn a Nerve, and a twisted Nerve or Nerve tied together; because in shape and colour it counterfets a Nerve: and otherwise the term Ligament, may in a large signification be applied to any part, which fastens divers parts together. Also *Galen* calls the beginning of a Muscle *Ligamentum*, part whereof is thought to turn to a Tendon. All these are improper acceptations. I shall now decipher a Ligament properly so called.

Its *Efficient* is the Ligament-making Power.

Its *Matter* is a clammy roaping part of the Seed.

Its *Use* is, like a cord to bind together the parts of the body, especially the Bones, and so to keep them together, in the Head, Chest, Back, and Limbs, that they may not be dislocated or disappointed.

Because of its most strong cleaving thereunto, a Ligament is said to arise (though it be indeed made of the Seed) from the Bone primarily, sometimes from a Gristle, gristly bone or Membrane: and its said to be inserted into a Bone, Gristle, Muscle, or some part. Or if you would rather have it so; Ligaments grow among the Bones, or in the Bones.

Their *Situation*. Some are without among the Bones, as the gristly Ligaments so called, which are thick and commonly round: others are wound externally about the bones which are thin and membranous.

As to *Figure*: some are broader which Anatomists term membranous Ligaments, as hath been said; others are longer, which are called Nervous Ligaments. And they call them so because of their resemblance, not as if a Ligament were truly membranous or nervous. So they are called membranous, which being broad and thin do compass the Joynts, also which are wrapt about Tendons and Muscles.

Its *Substance* is solid, white, bloodless, softer than a Gristle, harder than Nerves and Membranes: for it is as it were of a middle Nature betwixt a Gristle and a Nerve.

It is without Cavity, Sense or Motion. It was to be without Sense, least it should be alwaies pained in Motions; when as the Ligaments are made sometimes longer and shorter, that is to say, are contracted and extended. Some nevertheless will have membranous Ligaments to feel, but they must grant it to be so, by means of membranes and not of their own proper substance.

For this substance of theirs is as *Galen* tells us divisible into fibres visible to the sight, which experience also confirms.

Now this Substance is in some places softer and more membranous than in others, as in all Ligaments well-neer, which go round about the Joynts; and among these, it is softer about the Joynt of the Shoulder, than about that of the Hip; and yet softer where it goes about the interjoyntings of the fingers. But in other places the substance is harder and as it were in part gristly, and therefore they are in such places termed gristly Ligaments; and they are such as lie concealed among the Bones, as that which goes from the Head of the Thigh, into the Hip-joynt.

Chap. IV. Of the Skull in General.

WE divide all the Bones of the Skeleton into the HEAD, TRUNK, and LIMBS; and them into the Arms & Legs. *The Division of the Skeleton.*

The whole structure of the Bones of the Head is termed CRANIUM the Skul, because it is as it were *Crānos* an Helmet; some term it *Calva* and *Calvaria*.

Its *Situation* and *Magnitude* follow the Brain and correspond thereunto.

Its *Figure* is natural or non-natural and depraved.

Its *natural* figure is round, that it may hold the more, yet a little longish towards the fore and hindparts, where it branches forth, that it may contain the Brain and Brain-let;

let; on the sides it is flatted, but more towards the foreparts; and therefore the hind-part of the Head is of greater capacity than the forepart: of which *Albionius King of the Longbeards or Lombards* made a Drinking Cup for Festival daies, as *Diaconus* relates in his History.

Depraved Shapes of the Head eleven in number.

The depraved and non-natural Figure thereof is manifold.

1. When the foremore protuberance of the Head is wanting; and such persons are counted foolish and mad, for want of Brain, which ought to be most plentiful in the forepart of the Head.

2. When the Hinder Protuberancy or bunching forth is wanting.

3. When both are wantings so that the Head is round as a Ball, such as the Heads of the Turks and Greenlanders are thought to be. And these three depraved figures *Hippocrates* doth acknowledg.

4. The fourth Figure *Galen* adds, which he conceives may be imagined but not really found, when the length is changed into breadth. But *Vesalius* saies he saw such an one at *Venice*, and at *Bononia*.

5. The fifth way may be added also out of *Hippocrates*, an acuminate or oval Figure, when the Head rises up like a Sugar-loaf: which shape in some Nations *Hippocrates* tells us had a great reputation of Gentility, and may be formed by Midwives, when they swathe the Childs Head into such a shape and so preserve it; and at last Nature transfers such kind of Heads from Parents to Children. The same *Hippocrates* in his *Epidemics*, brings in two kinds of thus shap'd Heads, one with the strength of the parts, the other with weakness of the said parts. And such a figure of Heads, is at this day more frequent in some Countries than in others.

But now I will add other figures which I have observed in many Skuls, especially in *Italy*.

Other Shapes of the Head observed by the Author.

6. When the right side branches out.

7. When the left side sticks out.

8. When the right part of that bunchiness which naturally should be before is wanting, and the left sticks out

very much, in some more, others less.

9. When the left side of the said Protuberancy is wanting, and the right sticks out more than ordinary.

10. When the right part of the Hinder Prominency is away.

11. When the left part of the said hinder Protuberancy is away.

And thus I make *twelve Shapes* of the Head in all, one natural and eleven depraved.

The Substance of the Skul is boney, to secure the soft Brain. But in Children new born it is softer then ordinary, and in some places cartilaginous and membranous, especially about the Sutures, and most of all in the middle and upper region of the Head: and all these for the making the Birth more easie, that it might give a little way when it is pressed. But the Substance of the Skul is.

1. Thick, not thin, that it may more strongly resist external injuries.

2. Rare not compact. 1. Least it should weigh too much. 2. That it might contain Juyce for nourishment,

3. That vapors may exhale.

Now this Substance of the Skul doth consist as it were of a double boord or plate. It is seldom simple and single without a *Medullum* or middle matter, as I found it in the Dissection of a certain person, and seldom hath it three boords, But for the most part two as hath been said: some call them *Diploas*, the outer whereof being unhurt, the inner may be hurt. And each of these plates is commonly polished within and without, smooth and thick. Hence it appears how thick the Skul is, seeing it is every where in a manner double.

I say in a manner or wel-neer, which others do not observe: for in some places the Skul is single, thin and transparent. without any distance of plates. And therefore some Chirurgeons *The Error of Chirurgeons* are deceived, who in taking away the first Plate do think they must so long cut and prick, til blood comes out. The external Plate is sometimes eaten off by the Venereal Disease, and sometimes it sprouts forth Gums by force of the said Disease.

But the rarity or light compoſure of the Skul appears from that middle substance between each Plate, which they call *medullum*. This Substance, I say, is rare or light, lax, and receives little Veins: which also *Hippocrates* knew, who therefore warns us that the Skul is very easily inflamed, and therefore when the Trepan is used, the Iron must divers times be dipt in Milk and Water.

The Surface of the Skul, is external or internal.

The upper External is smooth and even; the lower or Basis, is rough and uneven, by reason of sundry Appendices and Processes.

The upper Internal is hollow, smooth; save that it hath the Marks of Veins, and certain Cavities, wherein the *dura mater* grows: the lower is very uneven by reason of divers protuberancies.

And every where there are frequent holes in the Skull, very small and placed without order, through which small Veins and Arteries pass, to the inner Cavity of the Bones, and the *dura Meninx*. But sometimes they are not to be found.

At length, that we may come to the parts of the Skull, we must know that the Skul doth not consist of one only Bone, least by one wound the whole Skul should be broken in pieces; but of divers: which are fastned together by the Sutures, of which in the following Chapter.

And some are Bones of the Skull, others of the Jaw.

The Bones of the Skull in persons grown to ripe years are eight, whereof two are common to the Skul, with the upper Jaw-bone, viz. the *cuneiforme* and the *spongiosum*. But there are six proper bones, which make up the Skul it self: One of the Forehead (in new born Children two) two of the Forepart of the Head, one of the Hind-part (in an Infant four) two of the Temples. And there lie hid in the Auditory passages, other six bones, on each side three little ones: the *Hammer*, the *Anvil*, and the *Stirrup*, to which a fourth is added called *Orbicularis*.

And thus there are perpetually in the Skul fourteen or sixteen Bones.

The Use of the Skul:

1. To be the Mansion and Bulwork of the Brain, which of it self is soft.

2. That through it Vapors may pass.

To the former use, its thickness and hardness is subservient; to the latter its rarity and Sutures.

On the Skul of a Man sometimes Horns grow, one whiles soft, another while hard like Rams Horns; sometimes fixed to the Skul, otherwhiles to the Skin, and they proceed from a thick, clammy and melancholick humor. There are examples hereof in *Paraus*, *Thuanus*, *Hildanus*, *Renodent*, *Zachius*, *Severinus*, and others; I also saw two horns, one at *Padua* in a Nunn, another at *Purmeren* in *Holland* in an old Woman, which was sufficiently long and hard: I have discoursed of these Horns in my new Observations de *Unicornu*, of the Unicorn.

Chap. V.

Of the Sutures of the Skull.

A Suture is a sort of connexion resembling the putting together of two Saws, tooth within tooth, or the making up of a Garment of many torn patches.

Such Sutures there are many in a mans Head: for an Head is seldom found without any Suture, such as *Aristotle*

An Head without Sutures.

Stole saw, and at Helmstadt and the Monastery of Heilbrunn in France such an one is shewed (as a Rarity) and is every where to be met with.

And such persons have not their Heads so liable to external injuries, but very much to inward Infirmities, because transpiration is thereby made more difficult. By which distinction, *Palopius* and *Columbus* do reconcile *Cassius* and *Robertus Constaninus*, the former of whom wrote, that the Head which had no Sutures was most liable to sickness, the latter that the Head without Sutures was more subject.

Sometimes through Age and Driness, the Sutures do so grow together in aged persons, that they are scarce to be seen; whereas they are in the mean season, more visible in young persons. Sometimes the coronal suture is only seen obliterated; but the temporal do hardly vanish, except all the other be first defaced.

The Number and Situation of the Sutures, is the same in a Woman and in a Man, contrary to what *Aristotle* thought; nor doth it vary in respect of figures, as *Hippocrates* and *Galen* would have it, unless very rarely. For *M. A. Severinus* observed between the sagittal and Lambda-fashion'd suture, another over and above of a triangular shape; and near the end of the said Sutures in another Skul, a new oval Suture.

Moreover, the Sutures of the Head of a certain Fool, did vary in figure, which all stuck up with one Hillock as it were. which I saw in three Epileptick Children at Naples, especially in the coronal Suture, which did suggest a new Cause and Cure of the Epilepsie or Falling-sickness.

The Sutures which knit the Bones of the Skul, are some of them called true and proper, others false and Bastard Sutures.

They are termed true; which meet together like the teeth of Combs, or like Saws, put together, which I have sometimes seen after Contusion movable, which also in most Skuls that are over dried in the Earth is common. They are also loose in Children, and therefore they open in Hydrocephalic or Water-headed Children, as I saw in a Boy at Hafsna, like to that which *Severinus* pictures out in his Treatise of Impossthumes, and *Donaus* describes.

The bastard Sutures are joyned like Scales and Tiles on a house-top, and therefore they are termed *Squamosæ conglutinationes*, Scaley-conjunctions, and may rather be termed joynings, seeing they are more like to an Harmonia than a Suture.

There are three true ones.

The coronal Suture why so called.

1. Is the foremost, and is called *Coronalis*. 1. Because the Ancients wore Crowns on that part of their Heads.
2. Because it hath some resemblance to a Crown or Circle:

For from the Temples it ascends on both sides, athwart, to the top of the Head: The Arabians call this suture *Ar-cualis* and *Puppis*.

Its Use is to joyn the Fore-head bone with the bones of the Hinder-head, and to distinguish them therefrom. The place of the coronal Suture is found out in a living person, either by carrying the hand upwards from the Wrist along the Nose, or by drawing a Thread out from Ear to Ear, and another cross the same from the end of the Nose.

3. That which is opposite to this, is behind and in the Occipus or Hinder-head. 'Tis called *Lamdoeides* the Lambda-shap'd, from the Greek letter Λ . some call it *hupsiloides* from the letter *upsilon*, also *prova sutura*.

This ascends obliquely, from the Base of the Hinder-head, to each Ear, grows into an Angle. Sometimes when the Hinder-head is large or otherwise, 'tis divided by a transverse suture, simple, or double: sometimes there is a

double triple Suture as if a greater triangle did contain one or two lesser Triangles within the same: where the Bones so comprehended, are termed *officula triangularia*, the little three-cornered bones, commended, in the Falling-sickness.

The triangular Bones of the Skul.

Besides these triangular bones, *Olaus Worm* a rare man, found others in the Lambda-like Suture, which perforated both the Boards of the Skul, observed as yet by very few. Three for the most part on the right, as many on the left side, differing in magnitude, figure and situation, which also are accurately discerned and distinguished in Infants. The lowest is seen at the *Processus mammillaris*, the middlemost a little higher, scarce half a Fingers breadth, the third a little further distinct from the second. *Pavius* found only two like to these, circumscribed with their little Sutures or seams, which he doubts whether he should refer them to the Bones of the Occipus or the Bregma.

In Shape they are Various, Triangular, Oblong, Oval. sometimes in living persons I have observed them to grow so high, that I could feel them with my Fingers, as if they had been Epiphysis or somewhat growing upon the Bone.

All are larger on the left side, but the greatest exceeds not the Nail of a Mans thumb.

They appear more distinct on the inner & Concave side of the Skul, than in the outward and convex, and therefore they are all more clearly discern'd when the Skul is taken away.

We are nevertheless to observe that these bones of *Worm* do in divers Skuls vary, both in Number, Magnitude, Figure, Situation; so that sometimes there are four, sometimes two, and in a Right line only, sometimes in the very Juncture of the Sagittal with the Lambda-shap'd; sometimes also in the Scaley temporal Sutures.

Their Use, I believe, is 1. That the Sutures being enlarged thereabouts, might afford a more free passage for Excrements.

2. That the Skul being made up of more bones, might be more safe in Blows and Contusions.

The Use of this Lambda-like Suture, is to distinguish the bone of the Occipus or Hinder-head, from the bones of the Temples, and the forepart of the Head.

3. In the middle betwixt these two is the Suture termed *Saginalis* or Arrow-shap'd, because it runs in a straight line all along the Head, like an Arrow, betwixt the Coronal and Lambda-shap'd Sutures.

Sometimes it proceeds through the middle of the Coronal Suture and the midst of the Fore-head, as far as to the Nose, especially in Infants: in some also it cuts part of the Bone of the Occipus or Hinder-head. I remember it hath been sometimes wanting.

This Suture is termed *Virgata* and *Retia*.

Its Use is to distinguish and joyn together the two bones of the Sincipus or Fore-part of the Head.

Those two Sutures are commonly called *Nendose* or Bastard-sutures, which are wont to be called *Squamosæ Scalis*, *Cor-ticales* and *Temporales*, because they circumscribe the Bones of the Temples. Now this Connexion like Scales was necessary, because the Temple-bones, being in the lower part very thick would have been to heavy, if they had not been made by little and little thinner in their upper part, and joyned to the bones of the Sincipus attenuated by little and little like Scales.

Why some Sutures are like Scales.

Now there are many spurious Sutures every where in the Skul, also many harmonies, where the bones are joyned together: in the Palate bone a peculiar Suture is seen.

A great number of Sutures.

The Use of the Sutures.

1. They serve for the free transpiration of fuliginous vapors. And therefore *Hippocrates* pronounces, that they have soundest Heads, who have most Sutures: and those that have their Heads without Sutures, are troubled with an

The FIGURE Explained.

- A. A Portion of the Sagittal Suture.
 B. The Lambda-like Suture.
 C. The Skull cut with a Saw.
 D. The first Bone of Worms on the left quarter.
 E. The second.
 F. The third.
 G. The first of the right Quarters.
 H. The second.
 I. The third.
 K. The great hole of the Skull.
 LL. The mammillary productions.

an inveterate Head-ach. And Galen saw so great an Inflammation caused by over strait binding of the Head, whereby the Sutures were shut up, and the Excrements kept in, that the Patients Eyes came out of their holes.

II. That by them the *Dura mater* may be tied and held up, least it should squeeze the inner parts of the Brain.

III. That the said *dura mater* might by them send out fibres to constitute the *Pericranium* and the *Periosseum*.

IV. That Vessels may go in and out, to nourish and invigilate the parts; which Vessels are by *Fallopins* call'd *Vene puppis*.

V. That one Bone being broken the others might remain whole. And therefore *Galen*, *Paulus*, *Guido* and *Fallopins*, denie that there can be any contrasuture or Counterscleft, save in a solid Head without Sutures: *Hippocrates* writes the Contrary, and calls it a Misfortune, as also *Celsus* and others, and *Fallopins* himself, *Parvus* and *Pavus* relate examples, and before them *Soranus*, taking a similitude from a Glass Bottle, which oftentimes, being struck on the one side, is crackt on the opposite part.

VI. That Topical Medicines being outwardly applied, may more easily penetrate.

Chap. 6. Of the proper Bones of the Skul in particular.

The first Bone is the *Os FRONTIS*, the Forehead bone, which some call *Coronale*, *Inverecundum*, *Os puppis*: which hath

A Figure imperfectly circular; more perfect where it is circumscribed with the Coronal Suture, more imperfect neer the Eyes.

Its Substance is thinner than that of the *Os occipitis* or Hinder-head bone, and thicker than the *Ossa scincipitis*, or bones of the forehead part of the Head.

It is twofold in Children new-born, distinguished by the sagittal Suture: also framed of a twofold Plate, an external and internal.

At the top of the Nose above the Eye-brows, there are large Cavities commonly two in number, between the two plates, sometimes clothed with a green Membrane

and separated, containing a certain soft and marrowy body. But these Cavities are not 1. In Children til they are a year old. 2. In such as have a flat and Saddle-face.

3. In such whose Fore-head is divided.

The said Cavities have holes which end into the wide spaces of the Nostrils: and another which ends into the Skul, above the *Septum* of the *Os spongiosum* to distinguish the Organs of Smelling.

TABLE I.



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The Use of these Cavities.

1. To make the Voyce Melodious and Sounding; because they are not in such who have a bad Speech.

2. Some conceive they serve for the Air to be elaborated in, to generate animal spirits.

3. That they may contain the Air which is drawn into the Nostrils and brings the smells of things along with it, from whence it passes leisurely to the Organs of Smelling, and to the Brain to alter the same, and reduce it to its natural State, when it is disordered. And therefore it is that many times an whole day together a smell is perceived in the top of the Nostrils.

4. Others suppose, they serve to collect Excrements, not only thick but watry, which being carried to the *Glandula lachrymalis*, do make Tears.

5. Some conceive that the marrowy matter therein contained, doth pass through the hole of the greater Corner of the Eye, and moisten the Eye make it glib and slippery, that it may move the Easier.

This Bone hath Processes: one at the greater Corner of the Eye, another at the lesser, to constitute the upper part of the Eye-hole or Socket. There are also two corner Eminencies or risings on each side one, towards the Temples, which are termed Horns; by *Albucasis*, *Dionysius* the Author of the Definitions and *Flauius* the Physician; and if that boney Tumor be only on one side *Ingrassias* calls it *Dionysiscus*.

It hath three holes; one more inward of which before, which ends into the Skul: two outward, at the middle of the Eye-brows, for the thoroughfare, of the Nerves of the third Conjugation to the Forehead.

The Second and Third are the two Bones of the *Sinciput* or *Vertex*, which some call *Parietalia*, others *Acqualia*, *Nervalia*, *Rationis* or *Cogitationis*, of reason or thought: the Greeks *Bregmaria* ossa, because the most moist and soft Brain, is placed under them.

In Shape they are four square and unequal.

Their Substance is more rare and infirm then of other Bones, because the Head in this part, wants very much evaporation: and therefore the Wounds of the *Sinciput* are deadly.

why the wounds of the Sinciput are deadly.

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The FIGURES Explained,

In this TABLE
are presented the
Bones and Su-
tures of the Skul,
as also the parts
of both the Jaw-
bones.

FIG. I.

- AA. The Coronal Suture.
- B. A part of the sagittal Suture.
- CC. The scallia Suture of the Bones of the Temples.
- D. The Os frontis, or Bone of the Fore-head.
- EE. Processes of the said Bone, to the greater corner of the Eye.
- F. Another process to the lesser corner.
- G. A hole for the passage of Nerves expressed on one side.
- H. Os Bregmatis.
- I. The Bone of the Temples.
- K. Its Appendix call'd Styloides.
- L. Its mammillary process.
- M. Another process thereof which makes the Os jugale.
- N. The first bone of the lower Jaw according to our Author.
- O. The second Bone.
- P. The hole of this Bone, near which is the Caruncula Lachrymalis.
- QQ. The third Bone of the upper Jaw.
- RR. The fourth Bone thereof.
- S. The Partition of the Nostrils.
- T. The lower Jaw-bone.
- U. Its outer and lesser hole, the greater is to be seen within.
- X. The process of these Jaw-bones, termed Corone.
- Z. The other blunted Process called Condilodes.
- aa. The Dentes Incisores or Cutting Teeth.
- bb. The Dog-teeth.
- nnn. The Grinders or Grinding-teeth, Molares.

TABLE II



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FIG. II.

- AAA. The Coronal Suture.
- BB. The Sagittal Suture.
- CC. The Lambdoid.
- D. The Os frontis.
- EE. The Bone of the Sinciput, Bregma, or superior part of the Head.
- FF. A portion of Os Occipitis or Hind-head Bone.

In Infants, that part which is at the Conjunction of the coronal and Sagittal Sutures is found Membranous, and soft, and among all the Bones of the Head, it last receives a boney hardness, then when the Child begins to speak distinctly and intelligibly, while it remains Membranous and soft, it is not so thick as afterwards, but transparent. Hence in Children there is observed in that place a Gap or Chink, which some term *Fonsanella* and *fonticulus*; where also they are wont to make Issues in desperate Cantharis. I have once observed this part in a person grown up, to have been not yet boney, but membranous as in

Children, viz. in a man of years of Age. For in a Woman of twenty six years old, found it remaining open.

There are within superficial Cavities, being the insertions of Veins, and without certain small holes.

The fourth Bone of the Occiput which some call *Os proae*, *Os memoria*, *Os pigidis*, the Great Bone, doth constitute almost the whole hinder part of the part of the Skul.

Which in grown persons is commonly but as a double or treble; in Children it consists of two parts of four, seldom of five bones.

Its Figure is of a Spherical triangle,

Its Substance is the thickest and most compact of all the rest (because there the noble Ventricle is seated, and there the Nerves arise as from a Fountain) especially at the Basis of the Skull, save at the sides of the great hole, where it is most thin (and therefore in this respect Aristotle did well say, that this was the thinnest Bone of all, which Columbus taxes) and therefore for safety sake, there is in the middle thereof a long Prominency.

It hath five holes, one which is the greatest neer the first Vertebra, through which the *Medula oblongata* passeth forth; the rest are lesser serving for the going out of Nerves and the entrance of Veins and Arteries.

It hath nine Cavities, seven within and two without.

It hath before two broad Processes at the Basis (in Children they are Epiphytes) covered with a Gristle, within more eminent, inserted into the Cavities of the first Vertebra, for the motion of the Head. There is another small Process behind, joyned to the first Vertebra.

The FIGURES Explained.

This TABLE demonstrates the inner structure of the Organ of Hearing, with the little Auditory Bones.

FIG. I.

- AA. *Ossis temporis*, the Temple Bone.
- bbb. The scale Suture of the said Bone.
- cc. The *Ossis spongiosum*, or Spongy-bone.
- D. The Cavity into which the Auditory Nerve is inserted.
- e. The bony Circle.
- ff. The greater winding of the Cochlea.
- ggg. Three bony half-circles, which form the Labyrinth.
- h. The Malleus or Hammer in its situation.
- i. The Anvil or Incus.
- k. The Scapes or Stirrup.
- l. The external Muscle of the Ear.
- m. The internal Muscle of the Ear, of which see B. 3. chap. 9.

FIG. II.

- aaa. The Labyrinth.
- b. The Cochlea.
- c. The oval hole where the Scapes is seated.
- d. Fallopius his *Aqua-ductus*.
- e. The *Fenestra Rotunda*, round window.
- ff. Little holes to let out Veins and Arteries.

FIG. III.

- aa. The Cochlea dissected.
- bb. An intermediate space or thing dividing the Cochlea into two wreaths.
- c. A round hole, ending into the Cavity of Hearing, and the lower wreath of Cochlea.
- ddd. The wrappings or Circumvolutions of the Labyrinth opened.
- e. The *Fenestra ovalis*, or oval window.

FIG. IV.

- a. The round Head of the Malleus or Hammer.
- b. Its end whereby 'tis fastned to the Drum.
- c. The smaller process of the Malleus, Mallei or Hammer.
- d. The larger and more fine process thereof, first observed by Folius.
- e. The Incus or Anvil, whose upper part hath a Cavity to receive the Head of the Hammer.

In the Hinder-head of Dogs, there is another small bone between the Brain and the Brainlet, which is triangular: that it may as a Prop sustain their going with their heads downwards.

The triangular bone in Dogs.

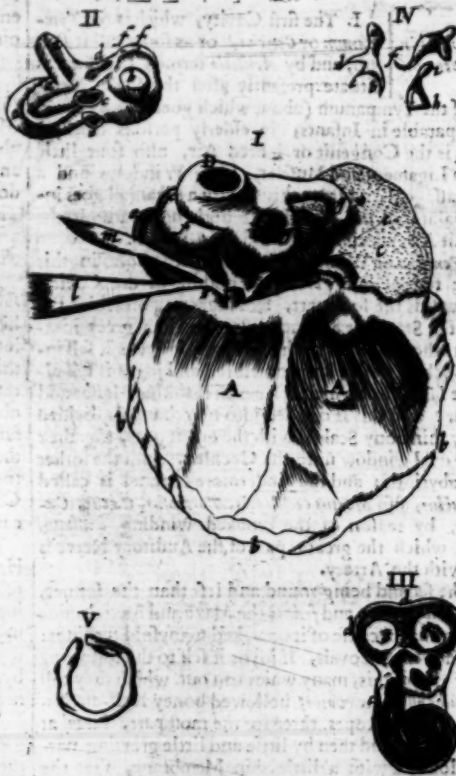
The fifth and sixth, are the Temple Bones, by the Ears; some call them *Lapidosae*, *Petrose*, *Saxae*, *Squamiformia*, *Mendosa*, and others *Parietalia* and *Arcualia*.

Their Shape is uneven (but rather circular than three square) because of their manifold Substance, which is like Rocks and craggy Cliffs; for which cause they are also called *Ossa petrosa* the rocky bones. But in their upper part they are attenuated, so as to be transparent, where they lie under the temporal Muscles, and are joyned to the bones of the Sinciput, like Scales.

They have six holes without, two within, the first external hole is large, viz. The Auditory passage; the rest are small, for Vessels to pass thorough.

They have two Cavities. The outer is covered with a Gristle, and receives the lower Jaw-bone. The inner is longish, common to the *Ossis occipitis*.

TABLE III.



- f. The longer process of the Anvil, to which the Stirrup is fastned.
- h. The Scapes or Stirrup.
- i. A fourth little bone fastned to the Scapes or Stirrup by a Ligament, first observed by Fr. Sylvius.

FIG. V.

Shews the bony Circle in Infans, to which the Membrane of the Drum is fastned.

It

It hath a certain *Appendix*, sharp, long and small, and therefore called *Strylaxides*, *Belonimies*, *Graphioides*, *Ple-Fram*, &c. It is soon broke off, and therefore it is not in all Skulls, especially such as are dug out of the ground. In grown persons 'tis bony, in Infants Gistly. It is a little crooked, like a Cocks Spur.

It hath three *Processes*.

1. Is *external* and obtuse, thick, short and cavernous, id est, having holes like a Sponge in it; its cal'd from its shape, *Mammillaris*, Dug-like.

2. Is *External* also, and a portion of *Os jugale*.

For the *Os jugale* or *Lygomatics*, seated under the Eye, is not a peculiar bone, but is made up of the *Processes* of two bones; the one is that newly mentioned, the other is that of the Jaw, joyned by an oblique Suture, making as it were a Bridge: whose use is to defend the Tendon of the temporal Muscle, the Skull being otherwise but thin in that place.

3. Is *Internal* with a long protuberancy, wherein there is a threefold Cavity: the *Drum*, the *Labyrinth*, the *Cochlea*, also the bones which serve the Hearing. But if the outer passage before the Membrane of the Tympanum be reckoned, there will be four Cavities of the Auditory passage. The Ancients makes mention but of one Cavern.

The Cavities in the *Osse petrosa*.

I. The first Cavity, which is the Tympanum or Concha, or as some call it *Pelvis*, and by Aristotle termed *Cochlea*, is situate presently after the little Membrane of the Tympanum (about which goes a boney circle, easily separable in Infants, in elderly persons hardly) wherein is the Congenit or inbred Air, also four little bones, a Ligament and Muscles, little Windows and a water-passage; and from this Cavity a Channel goes into the palate of the Mouth. It doth not transmit the Congenit Air, which Nature studies to retain.

The *Fenestra* or Windows, are two little holes in this Cavity: the one oval, is in the middle of the Cavity, more towards the fore-part, and higher, upon which the Basis of the *Stapes* or *Stirrup* rests, and in a great measure shuts the same: in the hinder part, it opens it self into the *Cochlea* with a large overture, and joyns it self also to the hinder hole which is lower in mankind, lesser and narrower; and this is divided into two channels, divided by a very thin bony Scale: with the one it goes, together with the oval window unto the *Cochlea*, with the other to the *Labyrinth*; and the hindermore channel is called *Aqua-ductus*, also *Meatus cochlearis*, *Torvusius*, *Cecus*, *Capreolaris*, by reason of the crooked winding passage, through which the greater part of the Auditory Nerve is carried with the Artery.

II. The second being round and less than the former, is called *Labyrinth* and *fodina* the Maze and Merral-mine or Cole-mine, because of its crooked manifold turnings: behind the *Fenestra* ovals, it joyns it self to the following Cavity. From this, many waies run out, which they call *Semicirculos ossis excavatos*, hollowed boney Half-circles, or *funiculos* little Ropes, three for the most part, large at the beginning, and then by little and little growing narrower, clothed with a little thin Membrane, that the sounds may become more acute, and being by little and little broken may so ascend unto the Brain. It hath four holes besides the oval, and a fifth which is terminated into the *Cochlea*.

III. The third is termed *Cochlea* because of its wreathed turning, others call it *Cavitas cochleata*, *Buccinata*, *Antrum buccinosum*, &c. for it hath three or four windings (those who are thick of Hearing have only one or two) mutually receiving one another, and is clothed with a very exceeding thin and most soft Membrane, and is adorned with infinite little Veins, which being twisted about the wreathings of the *Cochlea*, doth by many branches creep into the secret turnings of the *Labyrinth*,

Chap. 7. Of the Bones which serve the Sense of Hearing.

Here follow eight other Bones of the Head, which are least of all, on each side four, being the Bones subservient to the sense of Hearing, called from their shapes, *Malleus* the Mallet or Hammer, *Incus* the Anvil, *Stapes* the Stirrup, and the *Orbicular* bone: all which were unknown to the Ancients. The two first were found out by *Jacobus Carpus*, who was afterwards followed by *Massa*, *Jacobus Sylvius*, and *Vesalius*: and he being admirished by *Fallopins*, at last made mention of the third, whose first finder out was *Ingrasias*; although *Eustachius* and *Columbus* do arrogate the Invention hereof unto themselves.

The fourth Auditory Bone, was found out and shewed to me by *Franciscus Sylvius*, being round and small, and by *N. Fontanus* likened to the Scale of a Pike: annexed by a small Ligament to the Stirrup side, where it is joyned to the Anvil; which you shall more easily find in the boyled Calves Heads, in which they are bigger than in the Heads of Men: howbeit in a Man it is visible enough. *Pavins* found in the Head of an Ox a year old, one like this, of a sesamoidian shape.

They are situate in the first Cavity or Concha.

They have a substance hard and dense, hollow within, that they might be lighter, and might contain in them, Marrow for their nourishment, without any *Periosteum* about them: also that they might make the Air drier, and carry it along, like those Ropes which are fastened to doors to make them open and shut again of themselves. They are as perfect in new-born Children as in those that are grown up; though not so hard, but more moist, for which cause Infants are dull of Hearing.

The *Connexion*. The Hammer by its process sticks fast to the Membrane of the Drum, beyond the middle, like a tail turned back; the head whereof is articulated into the Cavity of of the Anvil, having a small Process, that the Tendon of the *Musculus rotundus* may be applied thereto; it hath also a longer Process, but smaller, first observed by *Cecilius Folius*, to which another Muscle is fastened, which belongs to the external Ear. It rests a thwart upon the bony circle, with which perhaps it grows together in persons that are of years, for commonly in Children it is only visible, in others it is easily broken because of its fineness, when the bones are taken out.

The Anvil resembling a grinding Tooth, lies under the Hammer, having beneath two processes; the one shorter resting upon the *Os squamosum*, the other longer sustaining the top of the Stirrup or triangular bone, which rests upon the *Cochlea*, till it is sunk into the broad Basis of the *Fenestra ovalis*, or oval window, to which it is fastened by a loose Ligament, so that it may be lightly raised, but not moved upwards and downwards.

These three little bones, are joyned with a very fine Ligament, which is stretched over the whole Membrane, as the strings over the bottom of a Drum.

The Use of these little bones is not to make a sound, but that the species of sound being received, may pass to the lower parts, and that there may be a passage for the excrements of the Ears. For the Stirrup shutting the oval or upper window, is moved by the Anvil (whereupon the window is opened, that the species or representation of Sounds may pass into the Nerve, and the Anvil being smitten by the Hammer, and the Hammer by the Membrane of the Drum, through the impulse of the external Air (which the Hammer hinders from being driven too far forwards) which while it is in doing, the membrane of the Drum is drowen inwards, and becomes bunching out, whereby the inbred Air is affected, which wandering through the *Cochlea* causes, that the branches of the Auditory

ditory Nerve, do receive the species of sounds, brought in by the windows; and communicate the same to the Brain. And thus the Hammer is moved only inwards. But in the recourse, it is moved outwards, with the Membrane of the Drum, by that very little Muscle found out by *Casferius*.

Chap. VIII. Of the Bones common to the Head and upper Jaw, viz. *Os* *cuneiforme* and *Os spongiosum*.

THe *Os Sphenoides* or *Cuneiforme*, or Wedg-fashion'd Bone, so called because as they say, it hath the shape of a Wedg; was by the Ancients called *Polumorphos* or many-form'd, by reason of sundry processes within and without whereby it is made rugged and uneven: others call it *Os Paxillare*, *Os Colatory*, *Os Palati*, &c.

'Tis seated in the middle of the Basis of the Head, and is placed under the Brain as a foundation, so that it touches well-near all the Bones of the Head and upper Jaw.

It is one Bone in grown persons: but it is at first made of four which are afterwards united.

The Processes are sundry.

Outwardly there are two remarkable ones, at the sides of the palate, call'd *Pterigoides*, *aliformes*, Wing-fashion'd, because they resemble the wings of Batts or Flittermice, and are furnished with a longish Cavity.

Inwardly there are four little ones, on each side two, having the shape of a Turkish Saddle. and therefore this process is termed *Sella Sphenoidis*, the saddle of *Os Sphenoides*; in which process being square and broad, there is a Cavity to hold the *Glandula pituitaria*.

At the Saddle, there is a Cave full of little holes, that the inbreathed Air, may be elaborated to make Spirits, and that flegmatick excrements, may distill through the funnel, out of the Ventracles of the Brain.

It hath sundry holes for the passage of the Vessels this way and that.

OS SPENGOIDES, *spongiosum* or *Spongiforme*, the sponge-like bone, being seated in the middle basis of the Fore-head, and filling the Cavity of the Nostrils, is also called *ethmoides*, *Cribiforme* or *Cribrosum*, the Sieve-fashion'd bone: because

Its inner side, where it joyns to the Head, is pierced through with many holes like a Sieve, winding and turning, but not streight; and this part properly is, and ought to be called *Cribrosa*, Sieve-fashion'd.

It hath in its middle a sharp Process, resembling a *Cockscomb*, by which as a Partition this bone is divided into two parts: And to this upper process another is opposed below, distinguishing the Nostrils, where the outer part of this bone is, which is contained in the Cavity of the Nostrils without the Skul, being light and spungie, and therefore there properly so called.

It hath also another part thin, solid and smooth, where it is joyned to the socket of the Eye, a small portion whereof it constitutes, but it is not a part of the upper Jaw-bone, as *Vesalius* would have it.

The Use of the spongie part is, to alter the Air drawn in with Smells.

The chief Use of the Sieve-fashion'd part is,

1. To admit the Air for Animal spirits.

2. That the Species of odours may with the Air be carried to the mammillary processes, the Organs of smelling, which end into these holes. And therefore in the Disease *Coryza*, this bone being obstructed, the smelling is lost.

A secondary use, is the purging of the Brain. for flegm is not only voided by the *Glandula pituitaria* into the Pa-

late, but it drops down also into the *Os cribrosum* and the Nostrils, if the upper Ventracles of the Brain so called, do abound with too much Flegm. Howbeit, this Flux is preternatural.

Chap. IX. Of the Bones of the Jaw in General.

THe Jaw-Bones are the foundations of the whole Face, the upper above the mouth the lower beneath.

For the upper, which *Celsus* calls *Mala*, is the boney part of the Face, comprehending the lower and lateral parts of the Eye-socket, the Nostrils, the Cheeks, the Palate, and the whole row of the upper Teeth.

And this Jaw-bone in Mankind, is shorter and rounder than in Brutes, for Beauties sake, also it is unmoveable as it is in Beasts, saving the Parrot, the *Phanicopterus*, and the Crocodile as well that which lives in the water, as the Land-Crocodile; yet do they not move the upper Jaw only, but their whole Head withall being straitly fasten'd thereto, as Vipers do, and the like is to be said of the Parrot.

But the lower Jaw-bone in Mankind and other Creatures, is only movable, save in the Crocodile, which hath it so united to the Bones of the Temples, that it can no waies be stirred; but the Parrot moves both.

The Connexion is without motion in the upper Jaw, by a Suture or Harmonie whereby it is joyned with many bones of its own, of which it is composed, and other bones placed round about; in the lower by way of *Synchondrosis*, which is in the middle of the Chin. But in grown persons, the Gristle is so turned into a Bone, that the lower Jaw seems to be one only bone, whereas before it consisted of two.

In the Brim or Circuit of each Jaw-bone, which place *Galen* calls *Phanhan*, we meet with Cavities, wherein the Teeth are fasten'd, which *Galen* terms *Bethria*, the Latines *Alveoles*, *Loculos*, *Fossulas*, *Præsepia*, *Mortariola*.

These holes according to the nature of the teeth in them, are sometimes single, otherwhiles threefold: sometimes they are obliterated and shut up, the Teeth being fallen or pluckt out. Sometimes they breed anew, by fresh Teeth breaking out. In old Age, frequently these holes are obliterated, the Teeth being lost, and the Gums become sharper and harder, so that old folks chew their meat with them instead of Teeth.

Chap. X. Of the Bones proper to the upper Jaw.

THe Bones proper to the upper Jaw, are eleven on each side five, and one without a fellow.

The first being in a manner triangular, doth make up the lower part of the socket of the Eye, the lesser Eye-corner, and part of the *Os jugale* and of the Cheek-bone.

The second makes the greater Eye-corner where there is an hole which passes into the Nostrils, by which a Caruncle is placed.

Here those Imposthumes are made which they call *agilopas*, which if they be unskilfully or negligently handled, they pierce to the Bone, and cause the *Fistula Lachrymalis*.

This is a little Bone, and the least among the upper Jaw-bones, Thin, Transparent, Loosely, Adhering, so that it is easily broken and lost: and therefore 'tis seldom found in Skuls dug out of the Earth.

The third is a very great one, by which are constituted the large region of the Palate, and the great lower socket

containing the Teeth. It hath large Cavities (and holes through which vessels pass) on both sides remarkable, both for to make it lighter, and that it might contain Marrow to nourish the Bones and the upper Teeth. Others say to help to frame the Voyce. In Children they are not hollowed til after some years, and they are then cover'd with a very thin Membrane.

The fourth with its companion, doth constitute the upper and more eminent boney part of the Nose.

It is thin, hard, solid and quadrangular.

And these two external bones of the Nose are divided with a suture. Within they are rough, that the Gristles of the Nose, may be the better fastened.

There is another inner bone (which is the third of the Nose) cleaving to the process of the *Os spongiosum*, which is called *Septum narium* because it distinguishes the Nostrils.

The first is seated at the end of the Palate, where the holes of the Nostrils go into the Throat or Fauces. They

The FIGURES Explained.

This TABLE presents the lower part of the Skul, to be seen within and without.

FIG. I.

AAAA. The two Boards of the Skull with the marrowy substance between them.

B. The Cavity in the Fore-head bone, ending into the wideness of the Nostrils.

CC. The *Os Cribrosum* or Sieve-like bone full of little holes.

D. Its acute process resembling a Cock's comb.

EE. The two innominate and fore-more processes of the *Os Sphenoides* or *Cuneiforme*.

FF. The two inner and hind-more processes of the said Bone.

GG. The holes of the said bone for the optic Nerves to pass out.

H. The Cavity cut in the middle of the Saddle, wherein the *Glandula pituitaria* is contained.

I. Another cavity wherein the conjunction of the optic Nerves doth rest.

KK. } Shew the holes of the *Os cuneiforme*, for the passage of the vessels.

MM. } The *Processus petrosus* of the Temple-bone.

oo. An hole in the said process, for the Auditory Nerve to pass through.

pp. An Additament or Appendix of the *Os Occipitis*.

Q. The greatest hole of the *Os occipitis* through which the spinal marrow passes.

RR. The Cavities of the *Os occipitis* within the Skull, in which the Cerebellum or Brainlets rest.

FIG. II.

AA. The fifth bone of the upper Jaw, distinguished by a Suture.

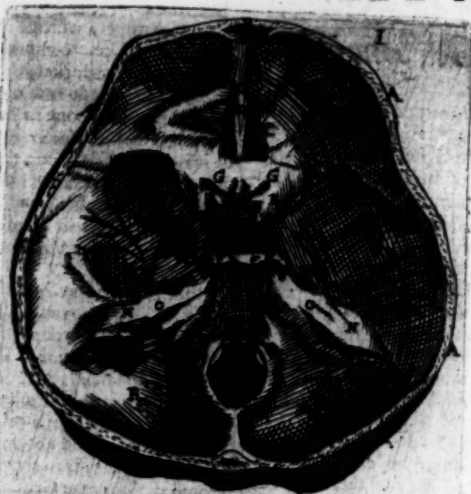
BB. The *Os jugale*.

CC. Holes opening into the wideness of the Nostrils.

D. The partition of the Nostril.

E. The eleventh bone of the upper Jaw, which Columbus calls *Alvism*.

TABLE IV.



FF. The external processes of *Os cuneiforme*, like Bats wings.

gg. The Cavity of these Processes.

HH. The Cavity of the Temple-bone, receiving the Head of the lower Jawbone.

I. An Additament or Appendix to the *Os occipitis*.

KK. The processes of the Temple-bones, call'd *Styloides* processes.

LL. The mammillary processes.

MM. Two Heads or processes at the Basis of *Os Occipitis*, whereby it is articuled into the first Vertebra.

N. The greatest hole of the said Bone.

OO. The two sides of *Os Occipitis*, furnished with divers protuberancies.

are distinguished one from another by the middle Suture of the Palate, and make the hinder part of the Cavity of the Palate and Nostrils, they are thin, solid and broad.

To these ten *Columbus* adds the *eleventh*, like a Plough, the inmost and middlemost above the Palate, shutting the lower part of the Nostrils, like a partition wall.

Chap. XI. Of the lower Jaw-bone.

The lower Jaw-bone in grown persons, consists of one Bone only, in Children till seven year old of two, which are joyned together by way of *Synchondrosis*.

Its *Figure* is that of the Greek letter *u* or like a Bow.

Its *Substance* is exceeding hard and strong, that it may hold out in biting and chewing; within hollow, where Marrow is contained to nourish it and the teeth.

It hath two *Holes* on each side, which go quite through the Jaw-bone like a Pipe, so that a bristle put in at one hole will come out of the other.

The one is more *inward*, hinder more and greater, receiving in a part of those Nerves which we reckon to be the fifth pair, to the Roots of the teeth, with a little Vein and Artery.

The other is more *outward*, less round, by which a Branch of the foresaid Nerve received in, is sent out to the lower Lip.

It hath sundry *Asperities* and *Cavities* for the Risings and Insertions of Muscles.

Also on each side two *Processes* called *Horns*, carried upwards.

One goes *outwards* broad and thin, whose point or sharp end is called *Corone*, into which the Tendon of the Temporal Muscle is implanted. And therefore *Hippocrates* counts the Luxation of the lower Jaw-bone deadly.

The other hinder more, is carried backwards; representing a little bunch and is called *condylodes*, having a little Head covered with a gristly crust, under which there is a longish Neck.

By this Process the Articulation is made with the Temples bones, where yet another Gristle is placed between the Cavity and the gristly head, to facilitate the motion. Also a common membranous *Ligament* doth cover this Articulation.

Chap. XII. Of the Teeth in General.

The Teeth are called *DENTES* as if you would say *Edentes*, Eaters, and by the Greeks *odóntes* as it were *edúntes* Eaters; and they are Bones properly so called, hard and solid, smooth and white, like other Bones.

How the Teeth do differ from other Bones.

They have some things peculiar which other bones have not, which nevertheless doth not exclude them from the number of Bones.

1. They are harder than other Bones, that they may bite and chew hard things; and they are little less harder than Stones, nor can they easily be burnt in the Fire, and whereas in the *Sarcophagi* or Flesh-eating Stone, the whole body is consumed in forty daies, the Teeth remain unimpaired, and therefore *Termtian* writes that in them is the Seed of our future Resurrection.

2. The Teeth are naked without any Periosteum, least they should pain us when we chew.

3. Yet they have a Sense, but more of the first than of the second Qualities, and especially rather of what is cold than what is hot contrary to the Nature of flesh, according to *Hippocrates*. and hence they are so apt to be set on edge.

But the whole Tooth doth not feel of it self, but the inner, softer and more marrowy part; which is covered over with an hard external part, which is not

Which part of the Tooth feels.

pained, neither by Fire, nor Iron, as in a Sword under the most hard rind of the Steel, an Irony marrow less hard lies within, and the Skin through the senseless Skarf-skin doth feel, so the inner part of the Tooth feels through the outmost, into which inner part being hollow, little soft Nerves enter and little cloathing Membranes. Hereupon a certain Nun at *Padua* causing a very long Tooth three had above all the rest to be cut off to avoid the Deformity thereof, she presently fell down into a Convulsion and Epileptick fit. Now in the part of her Tooth which was cut off, there appeared the tokens of a Nerve.

4. Hence, they receive Nerves into their Cavity which other bones do not.

5. They grow longer than any other of the Bones, almost all a mans life, because they are dayly worn, by biting and grinding; as

Gutta cavat lapidem non vi sed sepe cadendo.

The hardest Stone a dropping House-Eve hollows,
Cause drop upon drop, drop after drop still follows,
But not by force.

And look how much they wear away, so much are they still augmented, which hence appears; in that if any Tooth fall out and grow not again, the opposite Tooth grows so much the longer, as the empty space of the former Tooth comes to.

Fallopini considering the premises, and how new Teeth are thought to breed, he collects that the formative faculty remains alive in the Teeth to extrem old age.

Helmont counts the matter of the Bone not to be merely boney, but as it were of a middle nature betwixt Bone and Stone; because the Teeth turn to Stone whatever kind of food sticks long to them, be it Bread, Flesh, Herbs, Fish, Apples, Beans, or Pease, &c. But there is no petrification or turning to Stone, unless the things eaten be of a tartareous Nature, but only a drying, the moisture being consumed by the Spittle; nor are the Teeth made bigger by that addition, which sometimes is scraped off, sometimes turns to clammy filth.

The Teeth are bred in the Womb, after the Generation of the Jaw-bones, twelve in each Jaw, or a few more, as I shall speak hereafter touching their number.

The Teeth are bred in the Womb.

four Cutters, two Dog-teeth, six Grinders: which lie somewhat imperfect and concealed within the Jaws (for it is rare for an Infant to be born toothed) least the child as it sucks should hurt the Nipple. And therefore in an Abortion, or a young Infant, small teeth may be pulled out.

They break out of the Gums sooner in Brutes (though *Varro* be otherwise minded as touching Horses) because they are sooner capable of solid meat; in mankind at the seventh month or later, after the Child is a year old: and the upper sooner than the lower, yet in some the lowest first, and among the rest,

The fore-teeth in the first place, because

1. They are most sharp.
2. They are less then the rest.
3. Because the Jaw-bone is there thinnest.
4. Because there is most need of them both to speak with and to cut and bite the meat.

And at that time when the Teeth of Infants shoot forth, *Hippocrates* tells us that Feavers, Convulsions, Fluxes of the Belly arise, especially when the Dog-teeth come forth: because when the Teeth make their way through the Gums, they torment more than pricks in the Flesh.

Why Children are sick of Teeth-breeding.

These Teeth have a Substance boney, hard, and hollow where they break out, but in their hinder part they have a soft substance, covered with a thin and transparent Membrane.

And

Why and when young ones lose their Teeth.

And about the seventh and fourteenth year, other Teeth are wont to break out (the former falling away) in both the Jaws ten, four Cutters, two Dog-teeth, and four Grinders. And the former fall out in the fourth, fifth, and sixth year. because the holes grow wider, and therefore the Teeth being at that time soft, do grow loose and fall out. *Nicephorus* in his Interpretation of Dreams saies, that for a man to dream he looses a Tooth another comes in the Rome, betokens gain and unexpected Joy. If their Teeth do not shed, the latter Teeth come out at new holes, the upper commonly on the outside, the lower on the inside, as there were new ranks of Teeth. More frequently they spring out on the sides and augment the number.

Whether new Teeth are bred out of the womb?

But these Teeth are not bred anew without the Womb: for then likewise Membranes, Nerves, Vessels and Ligaments might be bred anew: but the seeds of them lie within the Jaws. For *Eustachius* and *Riolanus* have observed some smaller Teeth at the back of the rest which fall out, a very thin partition being removed which is found between the two sorts of Teeth. But a rare case it is for Teeth to breed again, after many years and in old age. As *Thuanus* relates of a man that was an hundred year old: in our *Fionia* a man of an hundred and forty years of age, had new Teeth. *Helmom* saw an old Man and Woman of sixty three years of age, whose Teeth grew again with such pains as Children have when breed they teeth, which was no token of their long living, for both of them died that year. Sir *Francis Bacon* hath the like Example touching an old Man.

But now let us speak of the Teeth in grown persons.

The Teeth are seated in the Comps of the two Jaw-bones, in Mankind, shut up within his mouth; in a Boar they stick out, as also in the Whale-fish call'd *Narhual* in our *Greenland*; which sends out an exceeding long wreathed Tooth, out of the left side of his upper Jaw, which is commonly taken for the Unicorns horn, and is yet of great value among Noble Men and Princes.

In Magnitude they come short of the Teeth of other Animals, because of the smallness of Mans mouth. And in Mankind some have greater, others less.

They vary in Figure. In Man they are of a threefold figure: Cutters, Dog-teeth, and Grinders, as shall be said in the following Chapter; save that *Fonsanus* observed in a certain Man, that they were all Grinders which he had. In Creatures that chew the Cud they are double; Cutters and Grinders. In Fishes they are in a manner all perfectly sharp, excepting one kind of Whale, which the *Islanders* call Springwall, whose teeth are blunt, but broad.

The Surface is smooth and even.

The Colour white, and shining, unless negligence, Age, or sickness hinder.

The Number is not the same in all Men, for to let pass rarities, viz. that some men are born with one continued tooth in their upper Jaw-bone (which they relate of *Pyrrhus*, and a certain *Groenlander* brought hither in the Kings Ships) also of a double and tripple row of teeth, such as I have seen in some Fishes, and such as *Lewis* the thirteenth King of France had, and which *Solinus* writes of *Manichora*, and is known of the *Lamia*, which hath five ranks, strangely ordered, and among them exceeding sharp teeth, resembling the stones called *Glossopetra*, and therefore *Columna* took the teeth of a *Lamian* turned to stone, to be the *Glossopetra* or precious Stones of *Malta* so called, of which I have spoke elsewhere. In a Sea-wolf, I have observed a double rank, the former of sharp teeth, the inner of grinders, close joyned together, which possess the lower part of the Palate. A man hath ordinarily but one rank in each Jaw-bone, and twenty eight in all, sometimes

thirty, in the upper Jaw sixteen, in the lower fourteen; but for the most part thirty two, sixteen in each Jaw.

But this number is seldom changed, save in the grinders, which sometimes are on each side five, sometimes four; otherwhiles five above, four beneath, or five on the right, and four on the left side, or contrarily.

A great number of teeth argues length of life, few teeth a short life, according to *Galen* and *Hippocrates*. And rightly.

For the rarity and fewness of teeth is bad as a Sign and a Cause: for it argues want of matter, and the weakness of the formative faculty. As a Cause: because few teeth cannot well prepare the meat, and so the first digestion is hurt, and consequently the second. But we must understand that this prediction holds for the most part, but not always, as *Scaliger* well disputes against *Cardan* in his 271. Exercitation. For *Augustus* who lived seventy six years, is said to have had thin, few, and scallie teeth; and so likewise *Forestus* who lived above eighty years.

Their Connexion is by way of *Gomphosis*, for they seem to be fixed in their holes as nails in a post. Also they are tied by strong Bands unto their nells, which bands tick to their roots; and then the Gums compass them, of which before.

The outer Substance is more solid and hard, not feeling; the inner is a little more soft, endued with sense, by reason of the neighborhood of a Nerve and Membrane, and hath in it a Cavity, larger in Children then Elder persons, and compassed about till they be seven years old, with a thin Scale like the Combs of Bees, and full of snotty matter; in grown persons the humer being dried up, it is diminished.

This Cavity is clothed with a little Membrane of exquisite Sense, which if it inbibes some Humor flowing from the Brain, extreme Tooth-ach follows. In this begin Erosions, Putrefactions, and most painful Rottenness; and herein sometimes grow the smallest sort of worms, which exceedingly torment men.

Vessels are carried to this Cavity, by the holes of the Roots of the Teeth.

As Veins to carry back the blood after nutrition and continual augmentation. Which are not seen so apparently in Mankind (as neither the Veins of the *adnata tunica* of the Eyes) but they are manifestly seen in Oxen, and are gathered from the sprinkling of blood in the Cavity.

Little Arteries to afford Natural Heat and Blood for Nutrition and Alteration. And therefore upon an Inflammation, a pulsative pain of the teeth is sometimes caused, which *Galen* experimented in himself. Hence much lightful, shining blood, comes sometimes from a tooth that has an hole made in it, and sometimes so as to cause death.

Little Nerves tender and fine, are carried to them from the first pare, according as we reckon, which go through the Roots into the Cavity, where they are spread abroad within, and by small twigs mingled with a certain mucilaginous Substance found in the middle of the teeth.

The Use of the Teeth

In the first and chieft place, is to chew and grinde the meat. And therefore such as have lost their teeth are said to content themselves with suppings; and therefore *Nicephorus* reckons that it is bad to dream of a mans teeth falling out, and saies it signifies the loss of a Friend.

2. They serve to form the voice (and therefore Children do not speak, till their mouths are full of teeth) especially the fore teeth which help the framing of some certain Letters. Hence those that have lost their teeth, cannot pronounce some Letters, as for Example T. and R. in the speaking whereof, the tongue being widened, ought to rest upon the fore-teeth. Also the loss of the grinders hurts the Explication or plain Expression of the Words, according to *Galen*,

Many teeth argue long life.

The Diseases and Pains of the Teeth, how caused?

Speech hurt.

so that the Speech becomes slower, and less clear and easy. Let therefore such as have lost their teeth, procure artificial ones to be set in, and with a golden wire to be firmly fastned.

3. For *Ornaments*. For such as want their teeth are thereby deformed.

4. *Homer* conceives the teeth are an edge to the tongue and Speech, to keep in a mans words, and prevent prating.

5. In Brutes they serve to *fight* withal, in which case a man uses his hands.

6. In the said Brutes, also to *shew* their Age. For the Age of an Horse is known, by looking into his Mouth, where before he is four years old that tooth to be seen which they term *Gnumon*, when he is four year old, there is another tooth seen with an hole in it that will hold a Pease, which every year grows less and less, till at eight years the tooth is filled up, becomes smooth, and no hole to be seen therein.

Chap. XIII. Of the Teeth in Particular.

IN respect of their threefold Shape, their Situation, and Office, there are in Mankind *three sort of Teeth*: The *Fore-teeth*, the *Dog-teeth*, and the *Grinders*.

The *Fore-teeth*, from their Office which is to cut the meat, are termed *Incisors* and *Incisori Cutters*, also *Gelsinai* the laughing teeth, because in laughing they are first discovered.

They are placed before, in the middle of the rest, in each Jaw four (some have only two in a Jaw, as large as four) broad and sharp like Swords, shorter then the *Dog-teeth*, and fixed in their Sockets with single Roots; and therefore they fall the sooner out, especially the uppermore. After these follow on either side

The *Dog-teeth*, so called, because of their sharpness, hardness, and use; for what the former cannot cut these do bruise and grind. They are commonly termed the *Eye-teeth*, not as some think, because they do almost touch the circumference of the Eye, seeing they hardly reach the lower part of the Lips of the Nostrils, but because a portion of that Nerve which moves the Eye, is carried unto them, and they are deeply rooted, and therefore it is counted dangerous to draw them, also when they are pained, the Eye-lids do pant a little.

Why Men
Have few dog
teeth.
These teeth are two in each Jaw, on each side one, broad and thick in their basis, and sharp above. For a Man did not need many of these kind of teeth, seeing he is a gentle Creature, and hath hands to defend and offend.

They are fastned with simple Roots as the *Fore-teeth* are, but they are more deeply and firmly rooted: for their Roots exceed all the other teeth in depth, and they are longer then the upper teeth.

The remaining hindermore teeth are called *Molars*, both from their shape resembling Mill-stones and their use, because they grind the meat after it is cut, they are rough and great, hard and broad. The Germans call them the *Cheek-teeth*.

In men they are *more in number* then the Cutters; but the contrary holds in fierce Beasts, which use their sharp also to fight with.

They are commonly *twenty*, on each hand in both the Jaws five, although the number varies, as was said before.

The two last of these are termed *Dentes Sapientia*, the Teeth of Wisdom, also the teeth of Sense and Understanding, because they do then first break out (sometimes with very great pains, and otherwhiles without any pain) when

men begin to be wise, about the twenty eighth or thirtieth year of their Age, and sometimes when they are very old; *Aristotle* saw them break out in some when they were fourscore, and *Walaus* at the Age of eighty three years. Sometimes they hardly appear, and otherwhiles they are scarce created; the Latins call them *Genuinos*.

These Teeth are fastned by divers roots, either two and three, as the lower Jaw-teeth, or with three and four, as the upper Jaw-teeth, which have more roots then the other: Because,

1. They hang of themselves, otherwise then the lower teeth which are fastned partly by their own heaviness.

2. Because the Substance of the upper Jaw is more rare and soft.

And so much for the first part of the *A Transition*. Skeleton, viz: the Head: Now follows the second Part, or Trunk.

Chap. 14. Of the Back-bone and its Vertebra's in General.

IN the Trunk or other Part of the Skeleton, all the *Vertebrae* of the Back-bone are to be examined, also the *Ossa Ischi*, the *Ribs*, the *Breast-bone*, the *Chennel-bones*, and the *Shoulder-blades*.

All that is termed the *Spina* or Back-bone, which reaches from the first Vertebra of the Neck to the *O coccygis*, or Crupper-bone. It is called *Spina* the Thorn, because the hinder part thereof is all along sharp-pointed like a thorn branch.

The Parts of the Spine or Back-bone are termed *Sponduloi* in Greek, in Latin *Vertebrae Whirl-bones*, or *Turning-bones*, because by means of them the Body is turned several waies.

And these Bones of the *Spina* are divided into seven *Vertebrae* of the Neck; twelve of the Back; five of the Loins, and five or six of the *O sacrum*; to which is added the *Crupper-bone*.

All the *Vertebrae* are hollowed, to contain the Spinal Marrow, they were to be many, not one, both for Motion which ought to be made forward and backward; also that the hurting of one might not draw the whole Spine into consent. The Father of *Nic. Fomanius* saw five *Vertebrae* or Whirl-bones of the Spina in a cluster like a round ball, in the Body of a Porter that carried burthens. And *Pavins* hath observed that in decrepit old people these *Vertebrae* grow together into one, the moisture being dried up, and the intermediate Ligaments hardened, which he represents by a Picture. *Tulpins* saw the Back-bone in a Boy divided into two parts, and *Salmuth* hath seen it broke asunder in persons that were hanged.

The Figure of the whole Back is, that sometimes it inclines inwards, as the *Vertebrae* of the Neck, to sustain the Gullet and *aspera Arteria*; and those of the Loins, for the Trunk of the Aorta and the Cava descending. Sometimes outwards, as of the Back, and a little of the *O sacrum*; that there may be a larger space for the Heart, Lungs, Bladder, Fundament and Womb.

And these Parts do bend more outwards in Women, for the sake of the Child in the Womb.

The Figure of each *Vertebra* above and beneath, is plane and broad, that luxation may not easily be caused, round within, convex and bunching out; but in the neck broader and more even, by reason of the *Wezand* and Gullet resting thereupon. On the outer or Back-point, the *Vertebrae* are furnished with many prominencies.

For there are three kind of *Processes* in every *Vertebra*.

I. *Four oblique ones*, two on the upper part ascending, two in the neither part descending.

II. *Two transverse*, for the Original and Insertion of the Muscles. And they are in the Vertebrae of the Neck broad and bored through; in the Back thick, solid and round, excepting the eleventh and twelfth.

III. *One sharp one*, in the hinder part, which is properly called the Spine or Thorn, and is wanting in the first Vertebra.

They have five Appendices. Two above and beneath at their Body; as many at their transverse Processes, and one at the extremity of the Spine.

There is a most wide hole in the midst of each Vertebra for to keep the Spinal Marrow in. Also there are other holes in the sides, which are lesser, to let the nerves out, which *John Leonicius* affirm to go out only at the joinings of the Vertebrae.

The Substance of each Vertebra, is thicker and more spongie in the inside: to which grow the *Epiphyses* and *Gristles*. For the extrem Parts of the Vertebrae, excepting the first of the Neck, are furnished with Appendices, between which there come thick and soft *Gristles*, that they may be more easily moved; so that above and beneath, they have *Gristles*, which in the Os sacrum are harder and drier, because this Bone is immoveable.

The Vertebrae are knit together by Articulation in the hinder part, viz. by the way of *Ginglomos*, but in the fore part by way of *Symphysis*, and that by very strong Ligaments or Bands.

Now the *Ligaments* of the Vertebrae are twofold.

Some do knit the Vertebrae above and beneath, and are shaped like the half Moon, thick, strong, fibrous, and snottie.

Others arise from the Epiphyses, as well the transverse as the sharp ones, which are membranous, by which the Processes are more strongly tied.

Chap. XV.

Of the Vertebrae or Whirl-bones of the Back in Particular

THE Vertebrae of the Neck are commonly seven. In Brutes for the most part six only, and *Busbequius* relates that the *Hyena* hath none, who is confuted by the Skeleton of that Beast in the custody of *P. Castellus*. These Vertebrae of the Neck, have some Peculiarities, whereby they differ from the rest.

I. Some of them have their transverse Processes cleft in two.

II. Also they have them bored, for the cervical Veins and Arteries, ascending into the Brain.

III. They have a cloven Spine or thorny Point.

The two first are joyned by Ligaments to the hinder-part of the Head, that they may stick most close to the Head, and have somewhat peculiar to themselves, which the other five have not.

I. Is termed *Atlas*, because it seems to bear the Head up, which rests upon the two hollows thereof. Some call it *Epistrophicus*, though more give that Name to the second. It hath no Spine or sharp Point, least the two small Muscles of the Head which arise from the second Vertebra, should be hurt when the Head is stretched out.

It hath a thinner, but more compact Substance. It receives, and is not received: and therefore it hath its Cavity covered with a Cartilage, to receive the tooth of the following Vertebra.

II. Is called *Epistrophicus* from turning: for out of the middle of its Body, there rises an Appendix (others call it a Process) round and oblong, like a Dogs tooth, about

which the Head with the first Vertebra is turned.

Hence that Appendix is called a tooth; yea and the whole Vertebra is by *Hippocrates* so called, by the Luxation whereof, he conceives an incurable Squinzie, is often caused.

An incurable Squinzie by Luxation of the Tooth.

The Surface of the Tooth is in some sort rough, because thence proceeds the Ligament, whereby it is bound to the Occiput or hind-part of the Head, about which also is wound a solid and round Ligament, like a Nerve in shape, wonderous artificially twisted, that the Marrow may not be compressed and hurt.

Now this second Vertebra is joyned with the first, by a broad Ligament, turned round.

The last does more agree with the Vertebrae of the Chest, and hath its last Process not alwaies cloven.

The Vertebrae of the Back are commonly twelve in number; to which so many Ribs on each side are articulated: seldom one is wanting; and there is seldom one more.

They are thicker then those of the Neck; less solid, and full of little holes, for the passage of the nourishing Vessels.

I. Is by the Ancients called *Tiphia*, because it is higher, and sticks out more then the rest.

II. Is termed *Maschallier* Axillaris the Arm-pie Vertebra.

The rest are called *Costales* the Rib-vertebrae.

The eleventh is termed *Arrhepäs*, because the Spine or sharp point thereof is straight.

The twelfth is called *Diaxosier* the Girder.

The five of the Loins are the thickest and greatest, being full of little holes, whose motion is looser then that of the Back, that we may more easily stoop to the ground.

The transverse Processes are longer, but thinner, excepting the first and fifth; but the Spines are thicker and broader, to which the Muscles and Ligaments of the Back are fastned.

1. Is termed *Nephritis*, from the Kidneys which rest thereupon.

The last, is by some called *Asphalites*, the stabilisher or underpropyer.

The rest agree with the others aforesaid.

The Os sacrum or holy Bone follows, so called, because it is the biggest of the Spine or Back-bone, for the Ancients termed that which was great, Sacred. Or because it lieth under the obscene or privy Parts, which Nature her self covers and hides: For *Sacrum* did also signifie execrable, as *Servius* shews from *Peronius*, commenting upon that Expression of *Virgil*; *Auri sacra fames*: the cursed thirst of Gold.

It is broad and immoveable, being the Basis or Foundation of the Back.

Its Figure is commonly triangular. It is in its fore-part hollow, smooth and even; behind it is bunching and rough.

Its Vertebrae so called, not in regard of use but similitude, are five, sometimes six, in young Children easily separable, in grown persons so glewed together, that they seem to be but one Bone. *Solomon Albertus* and *Pavivius* have sometimes observed them to be seven in Number.

Os sacrum properly hath no Vertebrae.

Galen makes the Os sacrum to consist of three Bones; because he comprehends the other Bones of Os sacrum under the Copper-bone, and calls that an Epiphysis, which others call Os Coccygis.

The Holes are not in its sides, as those of the former, but in the fore-part (which are greater, because there are greater Nerves) and the hinder-part; because at the sides in the Os Ilium or Flank-bone.

In the three upper Cavities are engraven, where the *Ossa Ilij* cleave to it.

OS COCCYGIS is the Cockow-bone, so called from the Shape it hath of a Cuckows-bill, is under the former, consisting of three or four Bones, and two Gristles. But I conceive there was a greater number of Bones and Gristles in that Danish Boy, who had a Tail growing out at his Rump.

The Os coccygis may be loosned.

Their Connexion is loose, and in Women looser then in Men, that they may give way.

1. In the Voidance of large Excrements.

2. In the time of Womens Travel, that the cavity may be more wide. And therefore some conceive that this Bone only gives way in the Birth, though *Pineus* be against it, and that the Pains of Women in Travel depend upon the Concourse of little Nerves in that place. Afterwards in sitting it comes forwards, and of its own accord returns into its place.

This Bone in Men bends more inward to sustain the Intestinum rectum; in Women outwards, because of the Neck of the Womb, and that the Cavity might be wider.

This Bone being hurt or broken, exceeding great pains are raised, as the Stories related by *Amatus* and *Donatus*, do witness. *Hofman* believes it is of no use, but is only the mark of a tail, as the Nipples in Men are only the signs or marks of Duggs. But the constant Doctrine of *Galen* is, that all Parts of the Body are made for some Use.

Chap. 16. Of the Nameless Bone, or Os Innominatum.

THE OS INNOMINATUM or NAMELESS BONE, which some term OS COXA or ILIUM, the Flank-bone, consists of three Bones, *Ilium*, *Pubis*, and *Ischium* joyned together by Gristles, till the seventh year it appears distinguished by a threefold Line, but in grown persons tis one.

The Os *Ilium* so called, because it contains the Gut *Ilium*, is the first part, which is the uppermore and broadest, knit to the Os sacrum, by a common membranous and most strong Ligament, although a Gristle also comes between.

Its semicircular and uneven Circumference, is termed *Spina Offis Iliy*, whose inner part hollow and broad, is termed *Costas*, the Rib; the outer part formed with unequal Lines, is termed *Dorsum*, the Back.

This Bone is larger in Women, and its Spine is drawn more out sideways, that the Womb of a Woman with Child may better rest upon it. And therefore women with Child do a little complain of this Part, as if it were pulled asunder from the Os sacrum and other neighbouring Parts to which it cleaves.

Or *pubis* or *Pessinis*, the Share-bone, is the second middlemore and foremore Part; which Bone is joyned to the Bone of the other side, by way of *Synchondrosis*, that is to say, by a gristle coming between; which in Women is twice as thick and loose or wide as in Men; that these Bones in Child-birth may be (not dislocated or disjoyned, but) loosned and made to gape, when the Child strives to come forth.

But now and then when the Childs greatness, or the narrowness of the place requires, the Share-bones are pulled asunder, as, besides the Authority of the Ancients, *Parvus* and *Riolanus* have observed in the Dissections of Child-ing-women, &c. and it is largely proved in the Anatomical Controversies of my Father *Bartholinus*: But this is not alwaies so, namely when the Child is soft and apt

to bend it self and comply with the straitness of the place when the way is slippery, the Bones much widened, &c. for then the loosning of the Gristle does suffice.

But whether the Share-bones are moved is another question. *Joh. Cajus* affirms they are moved by help of the right Muscle of the Belly. *Spigelius* also saies they are moved after a peculiar manner upwards, whiles the Body roule in the bed, the Legs being lifted upwards. *Riolanus* proves that the Share-bones are moved, not alone, but with the Hip-bone, by help of the same Muscles, this I say he proves by the Venereal Embracements, in which these Parts are moved; by the going of such whose Legs are cut off, and lastly by dancing.

But some doubts do as yet make me scruple this Motion.

1. Because *Cajus* himself confesses, that the Share-bones (I add the rest) are not moved of their own Nature, but by the bending of the Back-bone.

2. These Bones being joyned together by Symphylis, can have no motion, which *Riolanus* himself confesses.

3. I have assigned another Use for the right Muscles, above in Book the first.

4. These seeming Motions of the Bones, are not proper to them, but are motions of the Thigh or Back, whose motion they follow. For in the Examples alleadged, any man may experiment in himself, that both his Thighs and Back are moved; also he may by his hand perceive, that both the Muscles of the Thigh called *Glimaxi*, and the other adjacent Muscles are moved.

5. They ought to be immoveable, because the upper Parts rest upon them as on a Foundation, and we rest by sitting upon this Part.

In Women that have been lately delivered, these bones may be separated with the back of a thin knife, which they cannot be in others. Moreover, though the Share-bones are joyned by a Gristle, yet they have likewise two

Ligaments 1. compasses them about circularly. 2. Is membranous, which possesses the hole.

They are thin, and for highness fake furnished with very great Holes, which in women are more large and capacious, because of the Womb and Child, for the inner and lower Proccesses do bunch more outwards.

With the Os sacrum they constitute that Cavity which is termed *Pelvis* the Basin or Bowl, wherein are seated the Bladder, the Womb, and Part of the Guts.

OS ISCHION or the Hip-bone is the third part, which is lower and more outward, wherein is a large and deep Cavity, (they call it *Acetabulum*, the Saucer, and *Pix* is the Box) to receive the large Head of the Thigh-bone, which if it fall out, either by reason of some internal humore, or outward chance, a Luxation or Semiluxation is thereby caused. The gristley Procces of this Cavity, is termed *Supercilium*, the Brow.

The lowest Parts of this Bone are more distant in women then in men, and therefore their *Pelvis* or Basin is larger then that in men.

This Bone is knit to the Os sacrum, with a double Ligament, growing out of the Os sacrum: The one is inserted into the sharp Procces of the Hip, the other behind, into its Appendix, that the Intestinum rectum and its Muscles may be thereby sustained.

Chap. 17 Of the Ribs.

AS the Os Innominatum or Nameless Bone, is at the sides of the Os sacrum, so at the sides of the Vertebrae of the Back, are the RIBS. And therefore, ascending in the Explication of the Skeleton, these are now to be explained, as being the lateral Parts of the Chest.

The

The FIGURES Explained.

This TABLE presents some of the Vertebrae, the Os sacrum, Os innominatum, the Ribs and Shoulder-blade peculiarly, and their Particles.

FIG. I.

- AAA. The fore-side of the first Vertebra of the Neck, termed Atlas.
B. The hole through which the Spinal Marrow descends.
CC. The transverse or lateral Processes.
dd. The lateral Holes through which the Arteries ascend to the Brain.
EE. Two Cavities receiving the Occiput.

FIG. II.

- AA. The back-side of the second Vertebra of the Neck.
B. Its Appendix or Process, like a Tooth.
C. Its forked Spine.

FIG. III.

- AA. The hinder-side of the Back-vertebra.
B. Its upper Surface, left solid and full of small Holes.
CC. Its transversal Processes.
D. Its hinder Process or Spina.

FIG. IV.

- AA. The fore-side of the Vertebra of the Loins.
B. Its lower Surface, for the most part covered with a Gristle.
C. A Hole for the Marrow to pass through.
DD. The transverse or Lateral Processes.
E. The latter Process or the Spina.
II. Its oblique Processes.

FIG. V.

- AAAA. The hinder-side of Os sacrum, conspicuous by reason of its Knobs and Roughness.
B. The Hole for the descent of the Spinal Marrow.
CC. Its oblique Processes.
ddd. Its hindermore Processes.
eeee. Its Holes for the going out of the Nerves.
ffff. Its hinder Process which is forked.

FIG. VI.

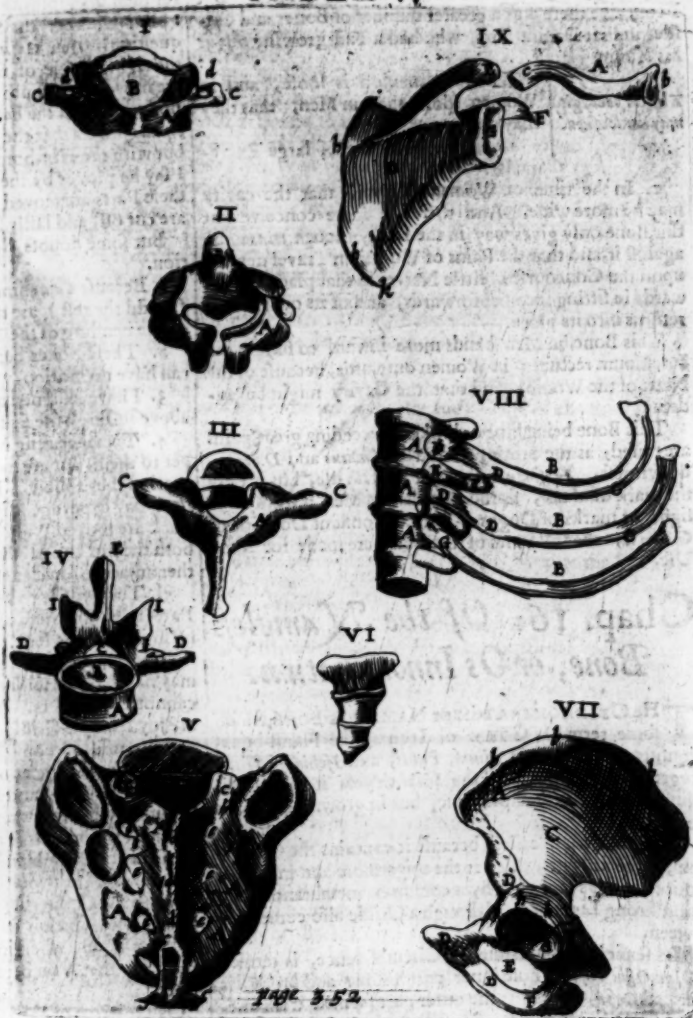
Shews the Os coccygis or Crupper-bone, consisting of four little Bones or Gristles.

FIG. VII.

Shews the Os Innominatum or Nameless Bone.

- AA. Os Ilium one part of the Nameless Bone.
bbb. The Spine thereof.
C. Its Back.
DDD Os Pubis the Share-bone, another part of Os Innominatum.
E. Its large Hole.
FF. The Os Ischion or Huckle-bone, a third part of the Nameless Bone.

TABLE V



- GG. The large Cavity or Saucer
hh. The Brim thereof.
I. The Knob.
K. The Appendix of the Huckle-bone.

FIG. VIII.

- AAA. The Vertebrae of the Back.
BBB. The Ribs.
CCCC. The Cavity engraven in the lower part of the Ribs.
DD. The two Knobs of the Ribs, by help whereof they are joyned to.
E. The Hollowness of the Vertebrae, and so the
F. Transverse Process of the Vertebra.
G. The lowest Rib, having a simple Knob.

FIG. IX.

- A. The Clavicula or Channel-bone.
b. Its small Head whereby its joyned to the Breast-bone.
c. Its other end whereby its joyned to the Shoulder-blade.
D. The Scapula or Shoulder-blade.
E. Its first Process, called acromion.
F. Its lesser, lower, and sharp Process called coracoides.
G. Its shortest Process called Cervix the Neck.
hh. The Basis of the Shoulder-blade.
i. Its upper Corner.
k. Its lower Corner.

The Situation of the Ribs in the Sides, and the Greeks call them *pleurai*, because they form the Sides.

In Shape they resemble a bow, or the lesser Segment of a Circle, that the Chest might be the larger. *Johan. Fontanus* found a forked Rib; and my self at *Hafnia* shewed the third Rib of the left side, as thick as two Ribs, joyned to the Breast-bone with two shanks.

At their rise they are narrower and rounder, but the nearer they come to the Breast, the broader they grow. In their upper part they are thicker. And the upper Ribs are more crooked, and also shorter; the middlemore are longer and broader; the lower are cut again shorter.

The external Surface is rough, where they are fastned to the *Vertebrae*, because the Ligaments which tie them do thence proceed: And there they are furnished with two little knobs: 1. Is articulated to the hollow of the *Vertebra*. 2. Is joyned to the transverse Processes of the *Vertebra*. But the five lower are joyned by a simple knob.

The inner side is smooth, because of the Membrane *Pleura*.

In the lowest part there are Cavities according to the length of the Ribs, for the Vein, Artery, and Nerve; which appears the more, by how much they are nearer the *Vertebrae*'s.

An Admonition for Chirurgens. Where let Chirurgens observe in the opening of the Chest, which is made between the six and six Rib, the Section must be made from the top towards the bottome, but not contrariwise: least these Vessels should be hurt.

The Ribs have Connexions; one with the *Vertebrae* of the Back, another with the Gristles of the Breast-bone.

The Substance of the Ribs, is partly bony, and partly gristly.

1 That the Chest may more easily be contracted and distended.
2 That a Fracture may not easily happen.
Tis bony in the part near the Back, and the lateral part. Its gristly near the Breast-bone to which they are joyned.

For all the Ribs in the forepart, have Gristles like Epiphysets, which in women (not in men unless very old) through tract of time, do grow hard as bones, that they may more strongly sustain the Bulk of the Dugs resting upon them.

The Gristles of the upper Ribs are harder, because they are coupled with the bones of the Sternum or Breast-bone; those of the lower are softer, because they are joyned to Gristles. Moreover in its hinder part each hath a Gristle, which is articulated with a *Vertebra*.

The Ribs are many in Number, that the Chest may be more easily moved. *Panfanus* in his Relation of *Athens*, tell us, that *Protophanes Magnus*, had his Ribs fastned one to another, from his shoulders to his bastard Ribs.

Nicholas Fontanus saw three united and unseparable. For the most part they are on each side twelve, both in men and women. Seldome thirteen, more rarely eleven. But often there is only one superfluous. Tis therefore likely that in one side of *Adam* there were thirteen ribs, one of which *Jehovah* took out with the muscular flesh growing thereto and turned into *Eve*; or he had twelve ribs on one side, and eleven on the other.

How many Ribs Adam had. The Ribs are divided into true, genuine and legitimate; and bastard, adulterate and illegitimate ribs.

The true are the seven upper ones, so called, because they do more perfect the Circle, and touch the Breast-bone, where with they have a perfect Articulation; and with the *Vertebrae* by a double knob as was said before.

The two uppermore are called *antistrophei, retorta*, turned backwards.

The two uppermore are called *antistrophei, retorta*, turned backwards.

The two following are termed *stereai, solida*, the solid Ribs.

The remaining three are call'd *sternitides*, the Pectoral Ribs.

The five lowest are called *bastard Ribs*, because they are lesser, softer, shorter, nor do they reach to the Breast-bone (that dilatation may be there better made, at the beginning of the lower Belly) nor have they a perfect Articulation therewith, but being knit only to the *Vertebrae*, as if some part of them were cut off, they end into longer Gristles than the true ones: Which being turned back upwards, do stick one to the other, as if they were glewed together, the last excepted, which is the least, and sticks to none, and therefore tis truly spurious, that a larger space may be for the Liver, Spleen, and upper Guts being distended. Howbeit, the eleventh sometimes and the twelfth, are tied to the *Sepum transversum*: Sometimes, the last grows to the oblique descendant Muscle of the Belly, without the Midriff; sometimes it hath the Circumscriptor of its proper Muscle, which pulls it from.

The use of the Ribs is:
1. [Especially of the true ones] to defend the Breast and Bowels therein contained, as the Heart, &c.
2. To sustain the Muscles that serve for Respiration, and some others of the Belly.
3. Of the bastard ones, to serve the Natural parts contained in the Belly.

CHAP. XVIII.
Of the Sternum or Breast-bone.

The Bone of the Breast, which in the fore-part of the Chest rests upon the Ribs, and is spread thereupon (whence they suppose tis call'd *Sternum*) is by *Hypocrisis* termed *Stethos*: which Word nevertheless sometimes signifies

- 1 The whole forepart of the Chest.
- 2 Its Pain.
- 3 The Breast-bone as in this place.
- 4 The Orifice of the Stomach.
- 5 The sword-fashion'd Gristle.

Others call this bone *Os Gladiace* or *Ensigniforme* the sword-bone or sword-fashion'd bone, because of the shape of a Sword or rather such a Dagger as was used by the Antients: for it is convex, long and broad.

Its Substance is partly bony, but fungous and red, partly Gristly.

It consists of divers bones, not of one, as is commonly seen in old Men, the diversity of its bones appears, when you remove its Membranes. In Infants it is wholly gristly, excepting its first bone. Moreover, the upper bones are sooner made than the lower, and the middle parts, than the outmost: so that in conclusion, eight bones are found in the Breast of a Child, which after seven years grow together, and become fewer, so that in grown persons there are sometimes three, sometimes four, sometimes more bones. But the first and last remain in grown persons as in Children; but the middle ones growing together, the number of bones comes to vary in that place.

These Bones are distinguished by transverse lines, and are knit together by *sambondyosiss*; for the Gristles are interposed like Ligaments.

The first and uppermost bone, is large and thick, plain and uneven, of an Half-moon fashion above, representing the joyning of a Dagger blade into the hilt, some term it *jugulum* the Throat-pit, others call it *Furculam* the little fork.

It hath on each side an hollowness in the upper part, to receive

receive the Heads of the Clavicula or Channel-bones, in which copulation Griftles come between.

And another Hollowness within engraven in the middle, that it may give way to the descending Trachea or Wind-pipe.

The second is more narrow and hath many hollownesses on each side to receive the Griftles of the Ribs.

The third is yet less, but broader than the second, and ends into the Gristle *Eniformis*, which is termed *Kapboides* Sword-fashion'd, and *Macronata* pointed, because towards the end it is sharp like the point of a Sword. The Arabians term it, the Pomegranate; *Avicenna* calls it *Epiglottalis*, and the common name is *Scutiformis* Shield-fashion'd.

This Gristle is triangular and oblong, sometimes round at the End, and sometimes broad, otherwhiles cloven, whence some call it *Furcula* the little fork; 'tis seldom double.

Sometimes 'tis perforated, for the Dug-veins and Arteries, which are accompanied by a Nerve. Sometimes in aged persons, it attains a bony Substance; *Veslingius* hath found it a Fingers length nor without great hurt to the Stomach, and trouble when a man bows himself. *Pavani* also saw here a bony Substance, in a person troubled with extrem shortness of breath.

This if it be too much pressed and bowed inwards, the parts beneath it are hurt, viz. the Liver and Stomach, and the Infants perish for want of Nutrimēt: of which see *Condronchius* and *Septalius*, *Zacutus*, *Wilhelmus Piso*. This Disease is by some Women call'd, the Hearts compression.

Folius hath observed two Muscles placed on the side hereof, by which this Gristle is lightly moved downwards and inwards.

The Cavity appearing outwardly in this place, is called *Fovea*, or *Scrobiculus Cordis*.

The use of the Sternum or Breast-bone, 1. Like a shield to defend the Heart from external dangers.

2. To sustain the Mediastinum.

3. To collect the Ribs and fasten themselves one to another.

CHAP. XIX. Of the Channel-bones and Shoulder-blades.

The Channel-bones are called *Clavicula*, *Cleides* in Greek, that is the Keyes; because they shut up the Chest, and like Keyes do lock the Shoulder-blade to the Breast-bone, or because they resemble the Keyes used by the Ancients, which *Spigelius* saw in an old house at *Pafus*. *Celsus* calls them *Jugula* a jungendo from joynings; others call them *Ligulae*, *Os furcatae*, *Furcatae superiorem*.

They are seated athwart under the lower part of the Neck, on the top of the Breast, on each side one.

They have the Shape of a long Latine S, that is to say, of two Semicircles, set one to another contrariwise, at the

Throat externally they are convex, inwardly a little hollowed, that the vessels carried that way may not be compressed. But in Men they are more crooked, that the motion of their Arms

may be less hindered in Women less, for beauties sake, seeing the hollows in that place are not so visible in Women as in Men, and therefore Women are not so nimble to throw Stones as Men are.

Their Substance is thick, but fistulous and fungous; and therefore they are often broken.

Their Surface is rough and uneven.

They are knit to the upper process of the Shoulder-blade (by a Gristle, which nevertheless grows not there-

to; that it may give way a little in the motions of the Shoulder-blade and Arm, only it is detained by Ligaments embracing the Joynt) by a broad and longish head, and with the Sternum or Breast-bone, it is joyned, by another little head, as was said before.

Its use is to serve the sundry motions of the Arm, which because it rests upon this bone as on a prop, therefore it is more easily moved upwards and backwards. And therefore it is that Brutes have no channel-bones, excepting the Ape, Squirrel, Mouse, and Hedge-hog or Urchin.

Os Scapulae the Shoulder-blade is by the Greeks termed *Omo-pla'te*, because it makes the breadth of the Shoulder, those that speak barbarously call it *Spatula*. It is a bone broad and thin, especially in the midst, but in its processes thick, on each side one, resting upon the upper Ribs, behind, like a Shield.

Its Figure is in a manner triangular.

Its Parts are sundry. The Internal is hollow, the other part (which hath both a corner and an upper and lower Rib) is gibbous, which is termed *Testudo* the Tortoise, also the Back of the Shoulder-blade. There is also a certain Spine or sharp-point, looking above and beneath the cavities which are termed *Interscapulae*.

It hath three Processes.

I. Is the extrem part of the Spine lately spoke of, and is called *Anomium* the Shoulder-tip, or *Summus Humerus*, whereby 'tis joyned to the Clavicula or Channel-bone.

II. Is lesser, lower and sharp, and from its likeness to a Crows bill, 'tis call'd *Coracoideus*; also *Anthurides* from the likeness it hath to one part of an Anchor, also *Sigmoides* and by this process, the Shoulder bone is contained in its place.

III. The shortest is termed *Anchor cervix*, the Neck; in the end whereof there is a superficial cavity, whereunto the Head of the Shoulder is inserted, which that it may not easily slip out, the deepness of the Cavity is increased by a thick Gristle, compassing the Lips. And by this process and Cavity, the Shoulder-blade is joyned with the Arm.

It hath five Epiphyses, three at the inside, and at the Basis near the carriage of the Spina. Two of them produce Ligaments, which joyn its head to the Shoulder, and the Shoulder-tip to the Clavicula: But common Ligaments thin and Membranous, do compass the Joynt of the Shoulder-blade and Arm.

Use of the Scapula or Shoulder-blade.

1. It serves to strengthen the Ribs.

2. For the Articulation of the Shoulder and Channel-bones, and for their security. And therefore the Shoulder is seldom (without very great violence) dislocated or disjoyned upwards, or to one side, but for the most part downwards, where no Shoulder-blade hinders.

3. For the implantation of Muscles.

4. Primarily for the action of laying hold according to *Hesman*, to which they are subservient, by inarticulation partly, and partly by the explanation of certain Muscles of the Arm.

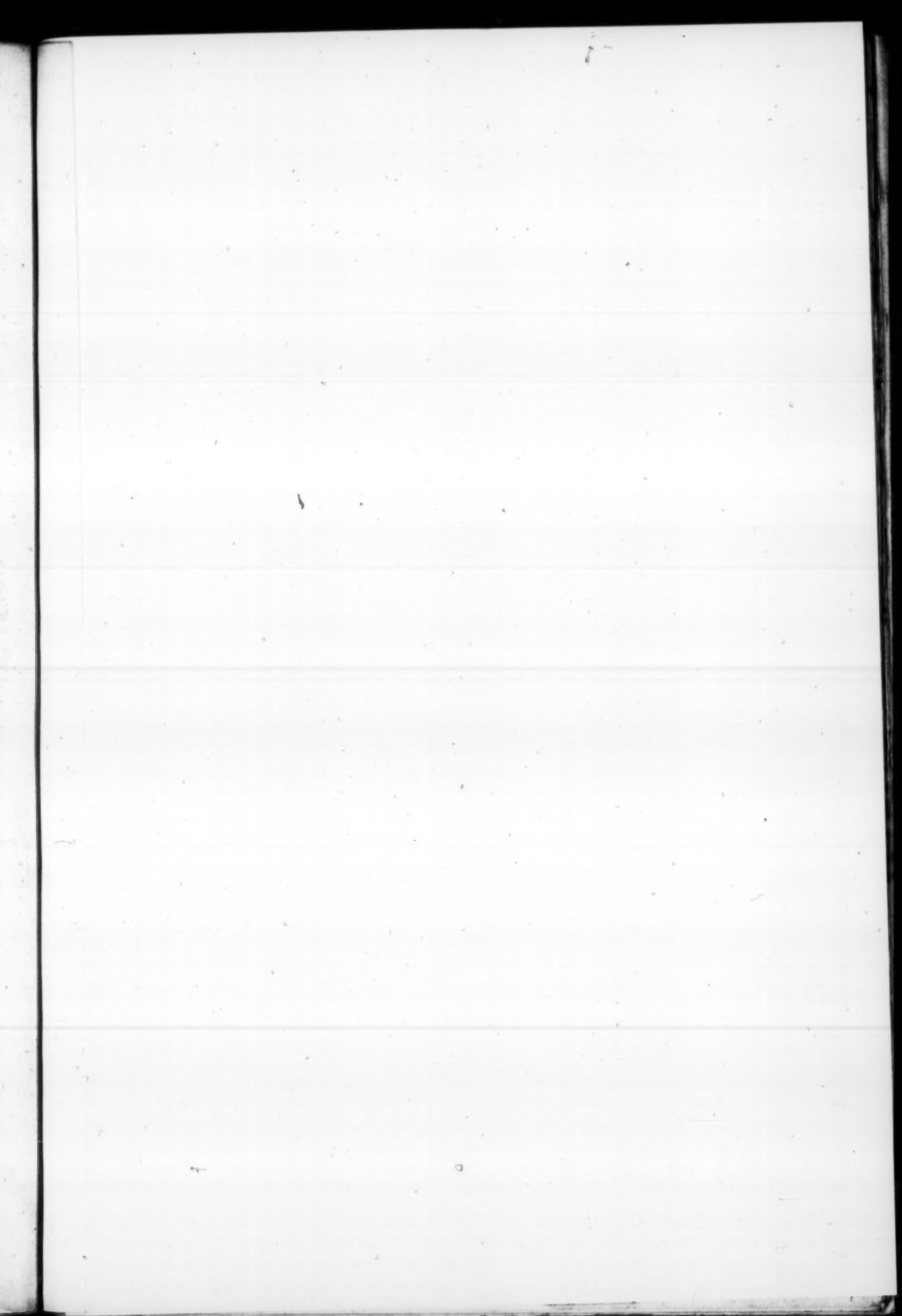
5. Secondarily to cover the Heart.

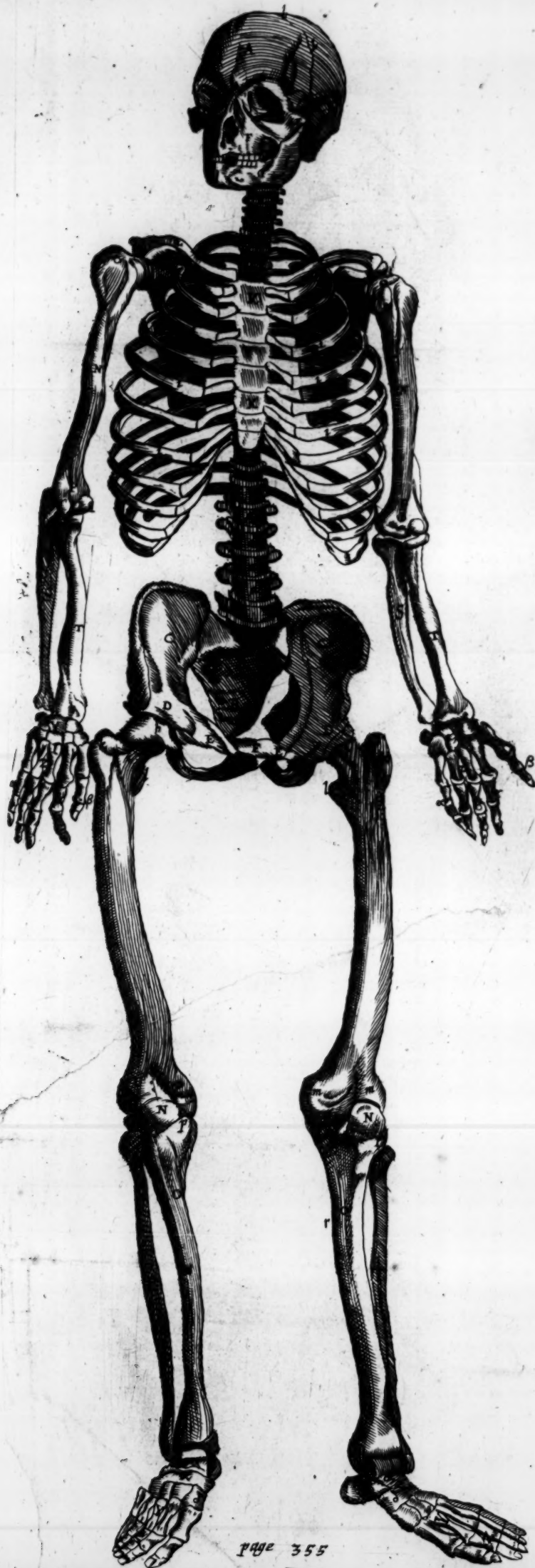
CHAP. XX. Of the Bones of the whole Arm and Hand.

The Bones of the Arm and Hand, are divided into the *Brachium* or Arm, peculiarly so called; *Cubitus* the Cubit, and *Extrema manus* the Hand.

The Os Brachii or Arm-bone, is a single Bone, great and strong, long, round, and uneven. In its upper part it hath an Appendix or great Head, growing to it, which is round, covered with a Gristle, and articulated with the Scapula by *Diaphysis*.

The





The lower part is articulated to the Cubitus and Radius, where there are two processes; the External which is less and crufted with a Gristle; the Internal having two Hollows; representing a Pulley, whereby the Cubit being joyned by way of *Ginglymus*, may be bent to a most acute angle, but not extended beyond a right line.

The *Bones* of the *Cubit* are two, shorter than the Shoulder, and having *Appendixes* on either side, resting mutually one upon another, and joyned one to another by a Membranous Ligament.

The first being lower, greater and longer than the other, is termed *ulna*, *Cubitus*, by the barbarous Writers *fole major*; the other being upper and lesser, is termed *Radius*, or *fole minor*.

The *ulna* or *Ell*, so called for some resemblance it hath to the Drapers Metwand termed an *Ell*, in its upper part is articulated with the Shoulder by *Ginglymus*, and therefore it hath there Processes, and Hollows.

The *Processes* are two, longwise shaped, and as it were triangular, rough, that the Ligaments might strongly close upon the Joyn and compass the same fast. They are termed *Coroïdai*, that is *Beaks*, *Bills* or *Acorns*. The *foremore* and uppermore is less, and goes into the hollow of the Shoulder: the *later* is thicker and larger and ends in an obtuse angle, and goes into the hinder hollow of the Shoulder. *Galen* calls it *Olecranium*, *Hippocrates* *Ancona*, the *Latines* *Gibberum*.

In the midst of these is a great Cavity or Hollow, like an half Circle, whence 'tis called *Sigmoides* from the letter *Sigma* so shap'd of old by the *Greeks*. It hath as yet another smooth external lateral Cavity, for the head of the *Radius*.

In the lower part it is articulated with the Wrist, both by a Gristle going between, as also by an acute process there-

fore termed *Styloides*, *Bodkin-like*, whence a *Ligament* arises, which fastens the Cubit to the Wrist-joyn.

The other Bone call'd *Radius* is more oblique or crooked, and is a little distant from the other in the middle, where a thin *Ligament* comes between: but above, the *Ulna* receives the *Radius*; beneath, the *Radius* receives it.

The upper part thereof is articulated with the outward part of the *Brachium*, by way of *Distribrosis*, whence proceeds the forward and backward motion.

The lower is articulated with an *Appendix* with the Wrist-bone, at the greatest Finger.

The upper part of this, is thinner, the lower thicker, contrary to what is in the former.

The Hand hath four sorts of *Bones*: those of the *Carpus*, *Brachiale* or *Wrist*; those of the *Metacarpus* or *post brachiale*, the *After-wrist*; those of the *Fingers* and the *Sesamus-seed-bones*.

The *Carpus* or *Wrist*, which the *Arabians* call *Rafetta*, hath eight distinct nameless *Bones*, very unequal, differing in *Shape* and *Magnitude*.

At their first original they are *Gristles*, afterwards they become *Spungie Boas*.

They are covered with very strong *Gristly Ligaments* and withall so fastned together, as if they were but one Bone.

And these *Ligaments* arising from the lower processes of the *Radius* and *Cubitus*, do serve for *Articulation*.

But there are other *Ligaments*, which are transverse and shaped like rings, for to strengthen and safely to carry along the *Tendons*, the *internal*, containing the tendons of the *Muscles* which bend the *Fingers*; and the *external*, containing the *Tendons* of the *Muscles* which extend the *Fingers*, which *Ligaments* or *Bands*, though they seem to be one, may be divided into many.

The FIGURE Explained.

This TABLE shews the Skeleton of a grown Body, that the contexture of the Bones may be seen one with another.

- A. The Bone of the Forehead.
- bb. The Coronal Suture.
- C. The Temple Bones.
- d. The Teat-like production or Processus mammillaris.
- E. The Os jugula.
- F. The upper Jaw-bone.
- GG. The lower Jaw-bone.
- hh. The Vertebra of the Neck,
- iiii. The Ribs.
- KK. The Sternum or Breast-bone.
- LL. The Clavicle.
- MM. The inner-side of each Shoulder-blade.
- NN. The Arm-bone or Os humeri.
- OO. The Head thereof joyning into the Shoulder.

- PP. Its lower part articulated with the Cubitus and Radius, where is
- qq. The inward knob thereof.
- rr. The outer knob.
- SS. The Cubit bone called ulna.
- TT. The other Cubit bone called Radius.
- uu. The Process of the ulna, crooked backwards, which *Galen* calls olecranium.
- xx. The lesser process of the ulna.
- YY. The wrist consisting of eight little Bones.
- ZZ. The Metacarpus consisting of four Bones.
- aaa. The Finger rows.
- ßß. The Thumb compounded of three bones.

These following Characters, do point to the lower Bones of the Skeleton,

- Aaaa. The five Vertebra of the Loyns.
- BB. The inner-side of Os Sacrum with its holes.
- CC. The Cavity of Os Ilii, constituting a great part of the Pelvis or Basin.
- DD. The Os Coxendicis with its Acetabulum or Sawcer.
- EE. The Share-bones with their Holes.
- F. A line knitting the Share-bones by help of a Gristle.
- GG. The Thigh-bone.
- hh. The round head of the said bone.
- ii. The Neck thereof.
- kk. The external process of the Neck, or the great Trochanter.
- ll. The other process or less Trochanter.
- mmmm. The lower heads of the Thigh-bone.
- NN. The Mola costella or Kneepan.
- OO. The Tibia right and left, in which
- pppp. Shews the two upper Hollownesses,
- rr. Shews the Spina,
- ss. The lower Process of the Ankle-bone.
- TT. The Fibula or other Leg-bone so called, or the Perone.
- uu. Its lower part constituting the external Ankle.
- XX. Seven Bones of the Tarsus.
- aa. The Astragalus.
- ß. The Calx, Calcaneum or Heel-bone.
- ß. The Os cubiforme, Die-fashioned-bone.
- YY. The bones of the Metatarsus.
- ZZ. The bones of the Toes, of which two are reckoned to the Great Toe and to the other Toes three a piece.

Place in here, The Skeleton of a grown body.

The bones of the Wrist are dispersed in a certain order: for above, there are four; articulated with the Radius and the Cubitus: beneath as many, knit to the four bones of the *Metacarpus* or After-wrist.

The *Metacarpium*, After-wrist, or Palm, hath four bones (others say five, reckoning the first of the Thumb amongst them) shaped longwise and small.

They are joyned to the Wrist by a Connexion of obscure motion, and by *Gristly Ligaments*: with the Fingers by way of *Ginglymos*.

These Bones are *fistulous* containing Marrow, hollow within, bossie without.

They have *Appendixes* on each side, which neer the fingers are round and longish heads, going into the hollow-ness of the Fingers. In the middle they gape one from another, where the Muscles cal'd *Inversus* do lye conceal'd.

The bones of the Fingers are *fifteen*, in each Finger three. For the first of the Thumb is reckon'd in this number, because it hath a looser articulation than the *post-brachialis*.

The row of Fingers on a hand the Greeks call *Phalangas*, because they resemble a rank of Soldiers in battle array.

Each of the Fingers have Ligaments on their insides, according to their length like Channels, whereby they are fastned one to another.

The bones of the Finger differ in *Magnitude*. For in every Finger, the first is greater than the second, the second than the third: and they are all thicker at the Joynr, where their knobs are termed *ἰδίοι, ἰδίοι*.

Without they are bunchings, within hollow and plain the better to lay hold.

They have *Processes* above and beneath, besides the bones of the third Interjuncture, which they did not need above where they are joyned to the Nails.

CHAP. XXI.

Of the Bones of the whole Leg, Foot and Thigh.

The Pes or Leg (taking the word in a large sense) is divided into three parts, as the Arm was: viz. into Femur the Thigh, Tibiam the Shank, and *Extremum pedem* the Foot.

Femur (the Thigh) is so termed a *ferendo* from bearing, because it bears and holds the Creature up, it consists of one only Bone, but the greatest and longest in the whole body, whose fore and external part is more bunching, the inner and hinder, more Saddle-shap'd.

For it descends obliquely inwards unto the Knee; which Chirurgeons are to observe, lest in the Fracture thereof they come to disorder this situation.

The upper part hath three *Processes*, which are rather *Epi-physes*, and are easily separated in young Children.

I. Is a most great and round Head, made of an Appendix, which is inserted into the *Acetabulum* or hollow Sawcer of the Coxendix, and is by a double Ligament fastned to the said Coxendix or Hip-bone: the one common, broad, membranous, but thick enough, compassing the Joynr round about; the other, round, as it were a Gristle (as if it were a Gristly Nerve) betwix the head of the Thigh and the Depth of the Cavity, lest the head of the Thigh fall out.

The Neck hereof hath a double *process* furnished with an Appendix, which Appendixes are easily plucked asunder in Infants, but not in grown persons.

II. Is external, which is called *Magnus Trochanter* or Rotator, the great whirler or wheeler about, having hollows, Impressions, and Lines.

III. Is internal, cal'd *parvus Rotator*.

Whole use is, for the original and Insertion of those

Muscles by which the motions are caus'd; and therefore also it is, that they are called *Trochanteres*; Wheelers of Whirlers about.

The lower part is articulated or joyned with the Shank by way of *Ginglymos*. For at the Knees, with a double head, the inner more thick, the outer more broad and flat, it enters the Cavity of the Tibia; between which heads there is a large space, of a Thumbs-breadth, through which the vessels do pass unto the Thighs with a Nerve of the fourth pare; and wounds in this part are dangerous, by reason of Convulsions.

Mola so called from its likeness to a mill-stone; is a round and broad Bone; it is in this place put upon the joyning of the Thigh and Shank, where the Knee is compass'd with a membranous Ligament, all save the *Mola*; others call it *Rotula*, *Patella*, *Mola*, *Scutum*, *Os scutiforme*, &c. the Kneepan, because it configures the Knee.

Its Substance for some months in young Children, is Gristly, in grown persons it becomes bony.

Its shap^a like a Buckler, for in the middle, one part thicker than the rest, bunches out.

It grows to, and is fastned by certain thick Tendons, of some Muscles of the Thigh.

It is *movable*, and for to make the motion more easie, inwardly at the Thigh-bone, 'tis cover'd with a slippery Gristle.

Its use is: I. To strengthen the joynr in that part, lest the Thigh should slip and be dislocated inwards, and so a man shall fall, especially walking downwards, and much bending his Knee. 'Tis reported, that in *Nova Zembla*, Men bend their Knees as well backwards as forwards.

II. To defend the Tendons of the Muscles.

Tibia the Shank, being that part which is between the Knee and the Ankle, consists of two Bones, as the Cubitus or lower half of the Arm.

The one being inner and greater, is called by the name of the whole, *Tibia*, *C. tina*; by some *os tibia majus*, *canna major*, &c. In an Elephant alone of all Creatures (as *Donatus* informs us) there is a bending or joyning in the middle of the Shanks, besides the other ordinary bendings common to all Creatures.

In the upper part it hath a *Process* in the middle received by the Cavity of the Thigh-bone, and two cavities framed longwise, for the Heads of the Thigh-bone; the depth of whose Hollows is encreased by a Gristle, fastned thereto by Ligaments, which is movable, soft, slippery, and smeared with an Oily moisture, thick in its circuit, thin towards its Centre, and therefore termed *Lunata*, Moon-shap'd.

A knob growing there, doth separate the two Cavities, from the top whereof a strong Ligament proceeding, it is fastned into the hollow of the Thigh-bone.

But from the fore and rough side come two Ligaments, which encrease the Moon-fashion'd Gristles.

Its foremost part which is sharp and long, is termed *Spina*, where the shape of the Bone is as it were triangular, and so acute that it is like the edge of a Knife, and therefore if the Bone of the Tibia or Shank be stricken on this forepart, it causeth exceeding pain, because the neighbouring Skin and the Periosteum are cut by this sharp Bone as it were with a Knife.

In the lower part there is a *Process* void of flesh, sticking out with a bunch, near the Foot, and 'tis cal'd *malleolus internus*, the inner Ankle-bone; as the process of the Fibula, is termed *malleolus externus*, the outer Ankle-bone.

Fibula peronea, the *Peron*, because it seems to batton together and joyn the Muscles of the Shank, is also cal'd *Sura* the Calf, *Canna minor*, *Os tibia minus*, &c. and it is a smaller and lankier bone, drawn along before the Tibia without, as the Radius before the Cubit.

In the upper part, its round head doth not touch the Knee, but it subsists beneath: but with its lower part, it goes beneath the Tibia, and therefore 'tis as long a bone as the Tibia is.

In the middle the Tibia and Fibula hold a gaping distance one from another, by reason of the Muscles of the Feet there placed, in which space a thin broad Ligament joyns these Bones together, according to their longitude, 'tis joyned also to the Tibia, by a common Ligament, above and beneath.

Beneath, the Head becoming sharp, hath an *Appendix*, which growing thick, begets a process called *Mallolus extensus* the outer Ankle-bone which is lower than the inner Ankle-bone.

The Bones of the Foot are divided as the Bones of the Hand, into three parts: into the *Tarsus*, *Metatarsus*, and the *Toes*.

The Bones of the *Tarsus* are seven, though some number only the last four to be in the *Tarsus*, because the three first have no Bones in the Hand answering to them.

I. It's call'd *Astragalus*, in Latine *Talus*, and commonly *Os Siliſte* the Sling-bone, also *Quatrio*, because of its four sides.

'Tis placed beneath the Shank bones as a Basis or foundation: for it is joyned with the Appendix of the Tibia by way of *Griffles*, wherefore they have upon a long Neck, an high, round, and smooth Head, covered over with a *Griffle*, in the middle whereof is a smooth Cavity: whereupon it comes to have on each side a brim or brow, like a pulley or little wheel on which a Rope runs.

At the sides it receives on each hand the Ankle-bones: it's also joyned with the *Os naviculare*, also below to the Heel, with a double joyn, where its lower part is uneven, twice hollowed, and thrice bunched. It receives the Head of the Heel-bone.

In the middle of these Joyns a Cavity is to be observed (to which the hollow of the Heel answers) wherein is contained fat and a slimy substance, to moisten the gristly Ligaments, which knit the Talus to the Bone, least in their motion they should be dried. Hence I have observed as often as there is scirrhosity of this moist and fat substance or none at all, either by means of a wound in that place, or any other cause, that there is a noise in a mans Foot when he walks, by the knocking of the two bones one against another, yet without pain, because there is no sensitive part within, but only Bones, Griffles and Ligaments.

II. Is the greatest and thickest in the Foot, as being the chiefest stability thereof (as the Talus is chief for motion) and therefore 'tis joyned by many Ligaments to the Talus or Ankle and other adjacent Bones.

'Tis called *Pteris talis*, *Calcaneum*, *pedis calcis*, the Spur of the Foot or Heel-bone, into which the greatest and strongest Chord or Tendon in the whole Body is fastned, being made up of the Tendons of three Muscles of the Foot.

Its lower part is somewhat broad, where it turns backwards, that the Foot may more firmly be settled and strengthened, otherwise a man would easily fall backwards.

In its upper part, it hath a large head, going into that shallow cavity which receives the knob of the Talus. But it is also joyned to the *Os cubiforme* or Die-fashion'd bone with its flat head.

III. Is called *Os naviculare*, *Scaphoideus* from the similitude of a Boat: 'tis knit to the Talus and the three hinder-most bones.

IV. From the form of a Die or four square solid body called a Cube, is termed *Cubo-ides*, cube-fashion'd, also *Os ciffere*, the Dice-bone, by the Arabians *Gran liusum*, by some others *Poſunorpha* many shap'd or many-fac'd. Being greater than the rest, 'tis placed before the Heel, joyned by an uneven Surface; with its other side 'tis joyned to the fourth and fifth bone of the *Pedus*; but within, to the seventh bone of the *Tarsus*.

The other three, anciently without names, call'd by *Fallopis*, *Calcoides*, *Cuneiformis*, wedge-fashion'd, are articulated to the *Naviculare* or Boat-fashion'd bone: and they are a

greater or middle siz'd, and a lesser from a broad Basis growing by little and little smaller and smaller.

The Bones of the *Metatarsus* or Sole, are five knit to the Bones of the *Tarsus*; those of the Toes are fourteen; because the great Toe is made up only of two Bones, and the Interjunctures are shorter than in the Hand, but those of the great Toe, thicker than in the Hand.

The other are like the Bones in the Hand which answer to them; as the Ligaments also commonly answer.

But under the sole of the Foot, the Skin and Fat being removed, there is a Ligament broad and strong; and from the lowest Bone of the Heel *Sefamoidean* little bones are inserted into all the ranks of Toes, for the greater firmness of the whole Foot.

Chap. XXII. and last.

Of the Sefamoidean Bones.

IN the Interjunctures of the Hands and Feet are found certain very little Bones called *Sefamini* or *Sefamoides* because they answer in likeness to Sefamus Seeds and also in their smallness.

They are round and a little flat.

They are less in the Feet than in the Hands, excepting in the great Toe, because it is greater than the Thumb is. In ancient persons they are greater and a little plane.

They grow to the Tendons of the Muscles which move the Toes, under which they lie concealed wrapt up in the *Ligaments*, so that they come away with them in the clefting of the Bones unless great Care be used.

Sometimes they are gristly, as in Children, in which they are not very conspicuous; otherwhiles bony, covered with *Griffles*, and inwardly Spungy and porous.

They are commonly twelve in number in each Foot and Hand, but sometimes sixteen, nineteen, twenty and more; sometimes there are only ten. They are more in number, greater and harder, in the inside of the hand than without, in which *Ristamus* faces there are none. Their number therefore is uncertain: for many are so small that they are not observed: and Nature herein as in a matter of small moment, sometimes abounds, and sometimes again comes short.

But those two are chiefly remarkable for their greatness which are joyned to the first Joyn of the great Toe, at the Head of the Bone *Metatarsus*; one which is the greater, placed under the Nervous part of that Muscle, which bends the first Bone of the great Toe, and the form and size thereof, is like the half of a great Pease, the white skin being taken off: which little bone is by the Arabians called *Albaidara*. Some Ancient Philosophers held that a Man should grow up again at length from this bone, as from a Seed, which *Corn. Agioppa* from the tradition of the Hebrews calls *Luz*. But another much less, is placed under the second Joyn of the great Toe.

And though most commonly these same very small bones are found in the Interjunctures of the Fingers and Toes, yet are they to be seen also in other places.

As sometimes in the outside of the Hand, where the eighth Bone of the Wrist is fastned to the bone of the *Metatarsus* which sustains the little Finger, there is one which fills an hollow place there: and after the same manner here is the like Bone in the *Tarsus* of the Foot, at the outside of the articulation of the fifth Bone of the *Metacarpus* which sustains the little Toe, with the *Os cubiforme*, or Die-fashion'd bone: also two little bones in the Ham by the *Os femoris*, which grow not in the Tendons, but in the Beginnings of the two first Feet-moving Muscles, which are found in old Men and in dry Creatures, as Deer, Dogs, and Hares. Hereunto they refer that bony part in aged people, which is placed against the *Oscubif*. m.

Then life is, and by their hardness, to retain them in their motions, lest they should fall from the Joynt when it bunches out.

II. To strengthen the Joynt and preserve it from Luxation.

III. To fill up empty spaces. And while these things

are performed by the said little Bones, the Hands do thereby lay firmer and safer hold upon any ground, and the Feet can stand and go more steadily, especially on rough grounds. To God our Creator be Praise, Honour and Glory, who hath form'd and fashion'd us so wonderfully.

FINIS.



TWO
EPISTLES
OF

Johannes Walæus

Concerning the

Motion of the Chyle

And the

BLOOD.

TO

Thomas Bartholinus

The Son of

CASPAR BARTHOLINUS.

THE FIRST EPISTLE

Concerning the

Motion of the Chyle and Blood,

TO

TO PARIS. }

Thomas Bartholinus the Son of Caspar.

The chief men in Church and Commonwealth have in all Ages contended about Primacy; but learned Men have in no Age more ambitiously striven who should seem most learned, then at this present time. And to attain their desire very many are not afraid to assist themselves by Calumnies, and other words

Arts. No man can publish in Print, or communicate to his Friend any writing, which some account excellent; but he presently meets with a Detractor who will prick, cut, and tear him most cruelly. Now for a man to seek nothing else by his Cares and Labours, but Envy and Vexation of Mind, is extreme madness.

THE

These Causes have (I confess) hindered me from satisfying your frequent Request; and besides, because I am not willing to determine of those things, which long experience of years cannot either prove, or sufficiently limit. Howbeit you continue your Request, and I am much ashamed, alwaies to deny you. Alfo a certain learned Man hath imposed a necessity upon me, in a manner, to discover to others my opinion concerning the Motion of the Blood. For certain Theses having been disputed concerning the Motion of the Blood, my self being President of the Dispute; though the Defendant truly professeth in his said Theses, that they are his own, yet he hath undertaken to tax and blame them, as if they were mine. And although that young man need not be ashamed of those Theses, yet I would not have another man's Theses, though disputed when I was President, to be accounted mine. Neither can he be ignorant of the Reason, who is acquainted with my Liberty in Disputing, or the Custom of our University.

The occasion of this writing

Now therefore take my Opinion of the Motion of the Blood, as follows.

That some hot blood which leaps out of the great Arteries being opened is thinner, more rare and of a more bright colour, than that which flows out of the Veins when they are opened: yet I will not therefore say, that the Arterial Blood differs formally from the Venal Blood: for the Arterial Blood may differ as aforesaid from the Venal, because it comes reaking hot as it were from the fire, and abounds with greater store of Spirits, as we see boyling Milk differs from it self being cooled, for the same reason: for that Blood which is in the smaller Arteries, and so farther from the Heart, is observed to differ less from the venal Blood. And when we have taken Blood out of the greater Arteries, yea, out of the Heart it self of a living Creature, and from the same Creature, have taken some out of the Veins, and have let them both grow cold and congeal, we could never observe any difference betwixt them. So that we can see no other, but that the Arterial Blood is of the same kinde with the Venal.

Some few will have, that the venal Blood is of two kinds, one which is contained in the *Vena cava*, another in the *Vena porta*. But we cannot see any difference of these Bloods either when they are included in their vessels, or when they are let out: and that Reason doth teach as much we shall see anon.

Besides these, we may likewise conceive another sort of Blood, which being made of Chyle in the Liver, hath not received any further perfection in the Heart. And we are little concerned to know the Nature thereof, because we see it continues such but a very little while. So that we are to enquire into the motion of only one sort of blood.

That it is only one kinde of blood.

Now the Blood may be moved either in that part of the Vein or Artery wherein it is contained, or out of that part into another.

It is not moved up and down in the Vessels like-boiled water.

In one part of a Vein or Artery, the Blood is not discerned to move up and down, like boyling water, neither when it is received into a Vessel, nor when let out of a living and hot Body; nor yet in the Artery it self, if it being on either hand tied, shall be opened in the upper part betwixt the two Ligatures. Yea, when we have many times cut off the point of a living Heart, and set it upright, we have found the Blood to be hot, but never to boyl.

But that the Blood is moved from one part of an Artery or Vein into another, is a thing very manifest. For Blood is contained in the Veins of the furthest parts of the Body, which seeing it is

not bred there, it must needs come from some other place. And it is evident enough, that in living Creatures, the Blood flows out of the *Vena cava* into the Heart and out of the Heart into the *Aorta*.

But that this same whole Motion of the Blood may be by us the better understood, I conceive our best way will be to begin at the very Fountains, and Original thereof.

I have often seen solid Meat in Dogs hold the same order in the Stomach, just as it was eaten by the Beasts; unless the Stomach being distended with too much Drink, did make the Meat to fix, and so to change its order and situation.

The Meat which the Stomach receives, although it be but two ounces, it evidently imbraces the same round about; just as we see folded purses contract themselves about a Bullet or round Ball within them, also the upper and lower Orifice are both shut: which by making an hole near the same, and putting in your little finger, it is easie to try. But the lower Orifice notwithstanding, when we finde it perfectly shut, seems rather to be fallen together, than straitly closed, that upon the smallest pressure it may let the Chylus pass by. Alfo many times when the Stomach and its Orifices are weak, they fail in their natural closeness, and upon searching are found looser.

The meat retained in the Stomach, as thoroughly moistened with the Liquor of our food, Drink and Spitile: and it quickly becomes porous and Spungie: because as is most likely the said Liquor hath drawn out and sucked into it self some of the substance of the Meat.

A while after it is cut and torn as it were into very small particles, both that of thin and that of gross Substance, yea, in Dogs the very shells themselves of Eggs: which doth questionless proceed from some acid sharp humour that hath in it a dissolving power. Some finde by experience that the Stomach burdened with the quantity or grossness of meat, doth find it self eased, by taking a little Vinegar, Juice of Citrons, Oyl of Sulphur, or Vitriol. Nor let any man assign the Cause thereof to Spitile or Choler belching back into the Stomach, when he shall see Bread steeped some hours in hot Spitile or the Gall of an Ox, by them not dissolved, moreover in an hundred Dogs or more which I have cut up on purpose alive, I found Choler flowed back into the Stomachs of onely two of them, one of which had eaten nothing for three daies, and in his Stomach, which was wonderful to behold, there was a Cholerick froath so thick and full of bubbles, as that we see on the Suds of such as wash in Lye.

Now I conceive this acid humor comes from the Spleen into the Stomach, because there is no other part in the body which we can perceive to be sharp or acid: and because upon swallowing a bit of boyled Spleen especially of a Cow, heaviness of the Stomach proceeding from the Quantity or grossness of Meats, is thereby holpen.

Thus the Meat being mixed in its smallest particles with the Liquor, in tract of time by concoction it comes to the consistence of thin Barley-cream: which when it hath strained, then at last it is thrust into the Guts.

Howbeit all Meat doth not receive this change in the Stomach in the same space

which motion perfectly to understand, the motion of the Chylus must be sought into.

That meat which is first eaten hath the first place in the Stomach.

The Stomach closely embraces the same.

It is moistured with the moisture of the Stomach.

It is cut and minced by an acid humor.

Which comes from the Spleen.

Afterward it is changed into Cream.

Some food is not changed in the same space

space of time; it is sooner performed in the day time, with a little meat thin of Substance and well chewed; it requires a longer space in the night, where there is store of it, the meat is gross, and swallowed down in great bits: so that the meat which is well grinded with the Teeth, begins to be turned into Cream, when that continues yet solid, which was swallowed down in great bits.

How soon or late it is converted and distributed. Milk and Breaths in the day time are perfectly digested in an hours space or sooner, and if somewhat else hinder not, they are then also distributed; which the voiding of Urin alone, after them, doth evidently shew, without any Dissection.

Herbs are more slowly changed. Bread in respect of Digestion seems to be of a midling Substance, we finde in the first hour and half very little changed; in the following hour it is rare and light, just like a wet Sponge; when that hour is past, it is divided into very small particles, and mist so with the Drink, that all appears liquid, and soon after it is most of all digested, and at last as much of the Bread as is digested, between the fourth and fifth hour after its eating, is by the Stomach forced through the Pylorus, into the Guts. But some of the said Bread stais behind, which by little and little is perfectly digested, as also if any other meat were eaten with the Bread of harder digestion than it: which meats I have observed to be digested in this order. First Beans and Pease, then Fish, then Flesh which is perfectly digested and thrust out of the Stomach between the sixth and seventh hour: Beef between the seventh and eighth: yea, and the membranous parts of the Animals are longer in digestion, as also the shells of Eggs; I have seen Bones that have abode in the Stomach unto the third day, during which space they were become like Gristles.

All at once or by piecemeal. Yea, and in the parts of these very meats, oft times great variety is seen, as of Bread and Flesh, though they seem whole in the Stomach, yet some portion though very little, is distributed sometimes the first hour, unto the Milky Veins.

So that whatever is digested, doth not at all expect the digestion of the rest, nor is staid by that which is undigested, but presently slips out, and is carried into the Guts: yea, and you shall seldom finde a Dogs Stomach empty, although he have not eaten in sixteen hours before.

Now I could easily make all these Observations in Dogs, which I cut up alive, at several distances after they had eaten their Meat.

Being digested it is distributed into the Guts and milky Veins. In the Guts the Chyle is of an Asche-colour, and is seldom coloured by the yellowness of Choler: and presently now from the Duodenum it begins to enter the milky Veins of *Affilius*, nor doth this entrance cease in any of the Guts as long as any Chyle remains in the said

Guts, so that the *Intestinum rectum* or Arse-gut it self, is endued with milky veins, which are many times seen to look white by the afflux of Chyle. And

See the Figure of the milky Veins, pag. 363. that we may not think that same milkie juyce comes elsewhere than from the Guts, I have bound these milky Veins inserted into the Body of the Guts, and observed that from the Cavity of the Guts to the Ligature they are evidently full and swoln, but from the Ligature towards the Mesentery they wax empty and fall in.

Not through the Meseraick veins But the Chyle hath never been observed to enter into any Vein in the body of the Stomach, nor any Meseraick Vein, nor yet the Blood being by the binding of *Vena porta* (whereof the reason shall hereafter appear) ex-

ceedingly augmented in the Meseraick Veins, hath ever been seen to enter into the milky Veins. So that I cannot see otherwise, but that Nature hath ordained the milky Veins only to carry Chyle, and the Stomach and Meseraick Veins only to carry blood.

The Chyle in the milky Veins is alwaies though it proceed from Ashe-colour'd Chyle in the Guts or such as is dyed yellow by Choler. *Alwaies white.*

By these Milky Veins the Chyle goes upwards, after what manner, is not very easie to say. This seems to me most probable, which I observed in great and lean Greyhounds; that some of the milkie Veins do go right on, to the *Ramus Mesentericus*, some into the *Vena porta* it self, others into the hollow parts of the Liver, and very few do sometimes end in the *Vena cava*, near the Emulgentes. For these Animals have not that single kernel in the beginning of the Mesentery, which *Affilius* hath termed *Pancreas*, and which is wont to obscure the passage of these Veins; but they are furnished in that place with smaller kernels, for the most part five in number, which being distant by a man fist space one from another, through that space they afford free passage to some milky Veins. But seeing that above these kernels, there are fewer branches of the milky Veins (and some of them greater) than beneath, I am apt to believe, that near those kernels, the milky Veins are divided into branches, and that the said kernels serve, as elsewhere in the body, to accomodate the divarication or branching of Vessels.

Sometimes also I have been shewed milky Veins, which entered into the Liver, but when in the presence of the Shewers, I accurately examin'd the matter, we found them to be Nerves. *Not to the Spleen.*

The Chyle being carried through these milky Veins is mixed with the Blood in the *Ramus Mesentericus*, in the *Vena porta*, and in the very Liver also it self: for in what place soever you tie the milky Veins, they alwaies swell, because they are hindered from passing the Chyle to these parts, and the Ligature being loosed, they manifestly infuse the same into those parts. *But to the Liver.*

The Branches of the *Vena Porta* in the Liver although in sundry places they are knit to the branches of *Vena Cava*, yet are they never opened into a great branch of *Vena Cava*, but the smallest branches of *Vena porta* do transfuse this Chyle mist with Blood into the smallest branches of the *Vena Cava*; as is easie to observe in the Liver blown up when the Flesh is taken off, and it swims in water. And that the same happens to the rest of the Chyle mingled with the Blood, will be hereafter manifest. Out of the little branches of the *Vena Cava* in the Liver, the Blood is in the Judgement of all men poured into the *Vena Cava*: and when in live Anatomies it is tied above the Liver, it manifestly swells with blood flowing in. *Out of the Liver into the Vena Cava.*

Out of the *Vena Cava* it enters into the right Ventricle of the Heart, and either part of the *Vena Cava* being tied, either that which is seated above, or that which is below the Heart, I have many times observed, especially in an Eell, that it is quickly emptied towards the Heart which also Harvey hath observed chapter tenth of his Book. *Out of the right Ventricle of the Heart into the Vena arteriosa.*

Out of the right Ventricle of the Heart, it enters manifestly enough into the *Vena arteriosa*, and by it into the Lungs.

But I dare not say that any of the blood passeth out

of the right Ventricle of the Heart, by the partition wall, into the left Ventricle thereof, seeing I find open passages elsewhere, but none in this place. But my thought was, that the *Sepium Intermedium* partition of the Heart, was not through the *Septum Intermedium*, as a General Scholar, and of a candid Spirit, in his Exercitationes upon *Fisus* Philosophy part 3. chap. 17. relates how he had seen *Payanus* shew the Partition wall of the Heart to be transpassable, by sundry crooked and turning passages, and that they might be found out, if putting a Probe gently into one of the pits, you shall most leisurely thrust it upwards and downwards and to one side, and still seek a further passage till you meet with the end thereof. And the truth is I have divers times found it to succeed as he saies; but I have withall observed, that those waites and turning passages, were not at all made by Nature, but by the Probe or point of a Pen-knife, while we open a way already made, and seek one farther: for the flesh of the Heart is so tender and withall so consistent, that with the smallest touch of any thing that can bite, it is presently broken, and leaves a Cavity; so that we may also after this manner, find passages through the sides of the Heart.

That the Blood being entered by the *Vena arteriosa* into the Lungs, doth return through the *Arteria Venosa* unto the left Ventricle of the Heart, I do hereby collect, in that having bound the greater branch of the *Arteria Venosa* (in a live Anatomy) near the Pericardium or Heart-bag, we have seen it grow hard and swell towards the circumference of the Lungs, that part being emptied and falling in which looks towards the Heart, and when the Ligature was loosed, we saw the Blood move to the left Ventricle of the Heart: and this is very easily observed in Rabbits. Now this Blood, because it can come from no other place, must needs come from the *Vena arteriosa* thither.

Leonardus Botallus a most learned Man, at the end of his Book de *Catarrhis*, supposeth he hath found another way, by which the Blood may continually goe out of the right, into the left Ventricle of the Heart. A little above the Coronary Artery (saith he) I found a passage visible enough, near the right Earlet, which goes imperceptibly and rights forth into the left Earlet.

But not through the foramen ovale. This passage unless it be the progress of the *Vena cava* to the *Vena arteriosa*, which we call *Foramen ovale*, or another passage which I have sometimes found in a Sheeps Heart, as big as a Wheat straw, going with a crooked passage from one Earlet to another; unless, I say, it were one of these, I know not what for a passage it was.

And as for that *Ovale foramen* Eg-fashion'd-hole, it is not every where alike shut up, and oftentimes there is a very thin and transparent little Membrane growing in the middle thereof, which with the smallest touch of a Probe is easily broken, but it is very seldom upon any occasion found open, in grown persons. And the Blood flowing through the *Arteria Venosa* out of the Lungs, doth fasten the Membrane placed before that hole, so that even when it doth not grow to, hardly any thing can pass that way.

But that same oblique passage which I have seen in a Sheeps heart, doth many times pierce deep into the substance of the Earlet, but is very seldom carried into the other Earlet. And I conceive it was given the Earlet for its Nutrition, it not being wont to receive branches from the Coronary.

Now from such things as seldom happen, we cannot conclude any thing touching those things that constantly come to pass: for Nature frequently sports her self in the Fabrick of the Heart. So in the *Sepium Intermedium* or partition wall of an Oxes Heart, in the upper part according to the length of the Heart, sometimes I have found a Cavity, opening at the left Ventricle, about the point, which was as long and large as a mans Fore-finger. The like whereunto possibly *Aristotle* saw, when in his 3. de *partibus* Chap. 4. he saith the greater sort of Animals have three Ventricles in their Heart. For the greatest Animals that are, have but two Ventricles, as I observed in the Dissection of a young Whale.

So that the Blood cannot be thought to go ordinarily any other way, then through the Lungs into the left Ventricle of the Heart.

The Blood being thus carried into the left Ventricle of the Heart, goes from thence to the *Arteria aorta*, the middle and smallest Arteries: for they being bound in living Anatomies, do wonderfully swell towards the Heart, and towards the extreame parts they fall in, and the Ligatures being loosed, they evidently send the Blood to the remotest parts of the Body.

The Blood out of the smaller Arteries may enter into the Veins; for the Arteries have a way open into the Veins, by the common mouths of one opened into another. And to the intent we might be sure that Blood may pass by those mouths, we have freed the Vein and Artery in the Foot of a dead Dog, from such things as are wont to hinder their being seen, and we emptied the greater crural Vein, and bound it in the flank, lest any Blood might flow in that way, and in the Knee we bound both this Vein and its neighbouring Artery: and then with our fingers we forced the Blood in the Black Arteries, as far as to the Knee, and so we emptied the crural Artery, but the crural Vein we saw manifestly replenished; and seeing into the Vein tied above and beneath nothing could come or a very little out of its branches and yet it was much filled, and the Artery quite emptied; we did gather that the Blood, which with the Vein was filled, was driven by the little mouths out of the emptied Arteries, into the said Vein.

And that this Opinion is not new *Galen* himself shews in his 5. Chap. de *usu passus*. The Conjunctions of the mouths of the Veins and Arteries are not visible to our Eyes: and if you shall justly refuse to believe them as not credible enough, you may be brought by other reasons delivered by the Ancients to believe there are such things: and not a hard by this plain token, that in case a Man shall take any of those Creatures in whom the Veins and Arteries are manifest, as an Ox, an Hog, an Ass, an Horse, a Sheep, a Bear, a Lion, an Ape, or a Man himself, and open many large Arteries in the said Creature, he may draw all the Blood in his Body out through the said Arteries. I have divers times experimented the same, and finding alwaies that the Veins are emptied with the Arteries, I did persuade my self that the Opinion was true concerning the common mouths of the Veins and Arteries, and of the common passage of the Blood from one to another. Yea it is a received and common opinion, that the Arterial blood doth naturally enter into the smallest Veins, to the end that the part might be nourished with arterial and venal Blood.

And that indeed and in such the Blood doth naturally pass in living Creatures, out of the Arteries into the Veins by those little mouths, these signs do clearly witness.

He that in living Dissections shall consider that Quantity of Blood, which by the Arteries is conveyed to the parts and Veins, can hardly persuade himself to think, that it is all consumed in nourishing the parts: especially if he shall consider that the Arterial Blood is thick enough, and not a fourth part thinner than the Venal blood, as I have often observed, when I have sucked both of them to grow cold and coagulate, whence

And then into the Heart, the Arteria aorta, and the rest of small Arteries.

One of the Arteries the Blood by top man mouth.

Known to the Ancients.

we may justly conclude with *Harvey*, that the Blood which is communicated from the Arteries, to the Veins and Parts, does a great part of it, return back again to the large Veins.

The pressing a Vein below the orifice, in Blood-letting.

Moreover, when we open a vein in a bound Arm, if you press that part of the swelling Vein with your Thumb which is near the orifice, betwixt it and the Hand, or if you make such a ligature as the former betwixt the Hand and the Orifice, you shall see that no blood will come forth; whence it seems to follow, that the blood comes from the Hand, which flows from the orifice. And seeing some pounds of Blood are drawn away by such a Blood-letting, and so much cannot be contained in the lower part of the Veins of the Arm, it must needs come thither from the Arteries, which are not stopped by that Ligature above the orifice, as their Pulse remaining entire doth tell us.

The Ligature of a vein in living Anatomies.

But that we might see the same with our Eyes, we have divers times in great living Dogs, freed the large Vein and Artery in the groin, from such things as did hinder their sight; which may be easily done if they lie not beneath the Muscles; and we bound the said vein with a thread, and we observed that part of the Vein which looked towards the *Vena cava* to empty and fall in, and the other part towards the Foot exceedingly to swell, so that in regard of its fullness, it seemed harder than the Artery it self; but the ligature being loosed, the Blood presently moved upwards, and the fullness and hardness of the Vein was very much abated. And the Artery being bound, that part thereof did wonderfully swell, which was nearest *Aorta*, and the other part more remote did fall in through emptiness: nor did the Vein then bound evidently swell. And this we did many times and the effect was still the same.

Dissection of a Vein in living Creatures.

And that we might have no scruple remaining, and might observe withall, what was done within the Vein, we did lift up the Vein and Artery being thus made bare, and under them we

firmitly bound the Thigh it self, that the Blood might not move upwards or downwards, by any other Vein save that which we had lift up. Then the Vein being held up, and also shut with a Thread, as it is expressed in this Figure, we opened it above and below the Thread with a small orifice. Now immediately from that part of the Vein which was farthest from the Heart, the Blood flew but violently plentifully, and in a full stream; but that part of the Vein which was on the other side of the thread towards the Heart, did only drop out a few drops, whence it seemed to us to be a clear case, that the Blood did not come downwards from the greater Vessels, but upwards out of the smaller Vessels into the greater. Especially when having made another Ligature upon the same Vein further from the Heart, betwixt the foresaid Orifice and the Foot of the Beast, we saw no blood at all come from that Orifice, whence before it issued with such violence. For we conceived those drops which fell from the Orifice near the Heart, might proceed from Blood which possibly was in the Vein when it was opened, or which it might continually receive from some small Branch of the crural Vein situate above the thread; but this cause will anon appear more evidently.

It is easie to make this experiment without any opening of a Vein in such persons as have the Veins of their Arms very Conspicuous: In whom if you stop the Vein near the Hand with one Finger, and with your other hand force the blood upwards, and the whole Vein will appear empty, which will soon after be filled, when you take away your lower Finger, but not if you take only your upper; as *Harvey* also observed in the 13. Chapter of his Book. For the upper Blood goes into the greater Veins, and the Valve hinders it from descending, which will hardly let any thing pass by, unless the vein be so far widened, that a great space remain between it and the Valves. Seeing therefore the Blood comes out of the Hands and Feet, and they do not breed new Blood, so as to supply the whole Body therewith, we doubt not but that the Blood in those parts continually and naturally goes into the Veins, and one of the lesser Veins into the greater.

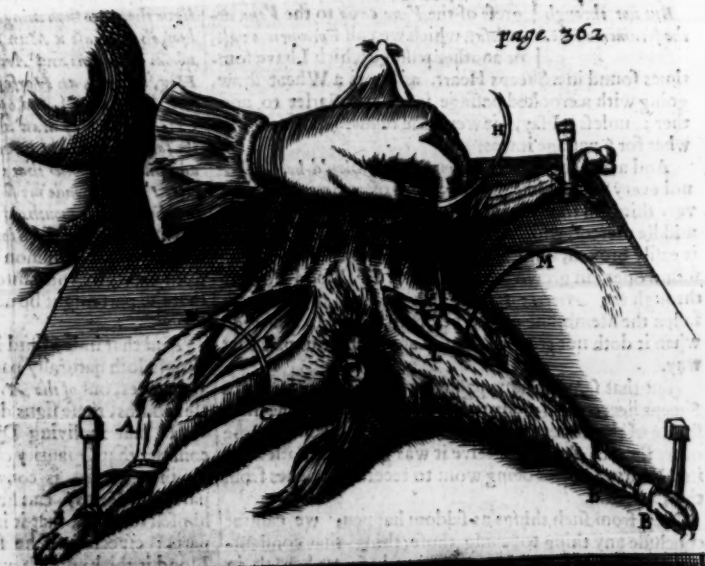
The emptying of the Veins appearing in the Skin.

TABLE I.

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The Explication of the FIGURE.

- A. The right Leg of the Dog.
- B. The left Leg of the Dog.
- C. D. The Ligature made under the Vein and Artery, which fast binds the Thigh, expressed in the right Thigh, least the confusion of the lines might disturb the Spectator in the left Thigh.
- E. The Crural Artery.
- F. The Crural Vein.
- G. The String wherewith the Vein is tied and born up.
- H. The Needle through which the thread goes.
- I. The upper part of the Vein which flaps upon the binding.
- K. The lower part of the Vein swelling after the Ligature.
- L. The drops of Blood which fall leisurely from the orifice in the upper part of the Vein.
- M. The stream of Blood continually issuing out of the lower part of the Vein towards



Nor do I fear that the Arterial Blood cannot be contained in the single coat of a Vein, which I see contained in the smallest little Arteries, and in an Aneurisma, where the Artery hath but one coat. And whereas the Arteries near the Heart have a double Coat, that might be so contrived, I think by violence of the Blood issuing out of the Heart, the Artery might be loosened; as we see it loosened by a strong palpitation of the Heart.

But the Blood doth not come out of the greater Veins into the lesser.

But doth not the Blood flow as out of the Arteries, so out of the greatest Veins into the lesser? This that kind of Blood-letting seems to argue, which is ordained for Revulsion sake: for the Vein of the Arm being opened in a Pleurisie, that Blood seems to be revelled or drawn back, which flowed out of the *Vena cava* into the *Azygos*, and out of the *Azygos* into the *Pleura*. But there is no token that the blood is so revelled; for the Basilica Vein being opened the blood may be drawn out of the Arteries of the Arm; the Arteries of the Arm draw out of the axillary Artery, the Axillaris out of the Aorta, by whose intercostal branches it had flowed into the Thigh, and not by the twigs of *Azygos*, as we shall see by and by. And doubtless, except in the Pleurisie, the blood should be revelled through the Arteries, there were no reason to be given why we should cut Revulsion sake rather open the Vein of the side affected, then that on the right side always; since the *Azygos* arises from the right side of the *Vena cava*, and that a Vein to be opened for Derivation is to be opened on that side through which the blood flows into the part affected.

Nor the Arms falling away occasioned by a Ligature.

But what shall we say? Doth not the Arm after a sort grow lean and fall away (and so other parts) when it is bound, as in those who have it hollowed in a Fistula? because the Vein being bound, the blood cannot descend as it ought, unto the lower parts of the Arm? There is no necessity that it should be so. For all that may happen because the Artery is bound. And really, this is an Argument that it is so, in that many times that Arm in which there is an Issue, is perceived to pulse less and more faintly than the other; the influx of the blood and spirits, being in some measure hindered, by the the binding of the Issue. Yet some part may peradventure fall away by binding of a Vein alone; because Nature cannot plentifully infuse new blood through the Artery, seeing it cannot freely go back by the Veins. And though the Veins and Arteries do then contain store of Blood, yet is it peradventure not very fit to nourish the parts as they should be, but this will better appear hereafter.

Nor the Varices.

It is nevertheless manifest, that in such as have the *Varices* so called, the blood descends from the *Vena cava* to the greater, and out of the greater into the lesser Veins. For that is easie to see in a Varix of the Thigh and Foot, and in the Hemorrhoids. But that motion of Blood may happen besides Nature, because the Veins being weakened do not fend the Blood upwards, but gather the same; and because the humors by that weight, do resist the Natural motion upwards, and descend, and therefore being collected in great Quantity in the lower Veins, new Blood still coming out of the Arteries; they cause their dilatation and consequently a Varix. Thus artificial Fountains about those places from which they ascend, are most frequently observed to make clefts, being at last drawn asunder and torn by the Heaviness of the Water, which ought nevertheless according to the Nature of Fountains to ascend upwards. And it is altogether most likely that Varices are caused after this manner: because humors in such as have Varices, do not enlarge the Vein, when they are violently moved in exer-

cise, but when they have rested after exercise; because the humors can resist a smaller motion and descend by their own weight.

So that these are not tokens, that the Blood goes out of the greater Veins into the lesser, but they argue rather that the Blood goes out of the Arteries into the Veins, and out of the lesser Veins into the greater, and the *Vena cava* it self.

We said before that the Blood goes out of the *Vena cava* into the right ventricle of the Heart. But what! Doth that very self same Blood, which

a little before had come out of the *Vena cava* into the Heart, and out of the Heart was shed into the Arteries, and from thence had returned into the Veins, doth that enter again into the Heart? or doth that alone which being newly bred in the Liver doth the first time enter into the *Vena cava*, and hath never yet past through the Heart? Truly both.

For that may easily be done, seeing both are alike near to the Heart: and it ought to be done; seeing that which is returned out of the Arteries into the Cava, is more plentiful than that, which is all of it consumed in the nourishment of the *Vena cava*, and that is not carried to the lesser Veins. Doubtless it is a sign that this is so, in that a Vein being tied near the Heart, is not only a little, but very much emptied, and sends all the Blood it hath, and not only some to the Heart.

Also the Heart seems to shed more Blood into the *Arteria aorta*, then the Liver can supply it withall, at least not in some daies fasting. For I have divers times experimented that

in many persons the Heart pulses above three thousand times in an hour. And the Heart as long as it hath any vigour left, expels somewhat at every pulsation: for the *Arteria aorta* being bound near the Heart, between the Heart and the Ligature, I opened the said Artery, and I saw some Blood come out at every pulse; till the Heart grew quite to languish, for then somewhat came away after three or four pulses only: because so little was thrust from the Heart, that it could not be moved upwards till some quantity of it was collected, nor pass out at the upper orifice of the Artery.

Also I cut off the tip of an Heart and setting the same upright, I observed though the Ventricle were not full, at every pulse somewhat was shed forth: which also *Hartveij* notes in his 3^d Chapter. Yea and when the Heart is cut through the middle, there ceased not to come somewhat out, till either the Beast died, or the Blood congealed so in the upper part, as to make a kind of small Scia, so that the Blood could flow no more that way. And certainly somewhat must needs come out of the Heart at every pulse, because there in the Heart is always made more strait, as shall afterward appear.

Now, how much comes from the Heart at every pulse, we cannot determine. this I can witness, that out of the Heart of a Rabbit there hath come

at every pulse half a dram of blood; and out of the Heart of a great Water-spaniel half an ounce: yet I conceive more comes out, when a live Creature is Dissected, than when it is in health. And if a man would determine by conjecture from what we have seen, how much may come out of the Heart of a Man in health at every pulse, I shall not be against them who say that out of the Heart of a Man at every pulse half an ounce of Blood is shed into the *Arteria aorta*.

But let us suppose it is but a scruple; seeing the Heart makes above three thousand pulses in one hour, there must above ten pound of blood pass every hour through the

But it flows out of the smaller vessels into the Vena cava.

Out of the Vena cava to the Heart again.

Yea that Blood which hath already past the Heart.

Because the Meat affords not so much Blood as the Heart passeth through.

Viz. about half an ounce at every pulse.

the Heart, which is more than we eat, and more than the Liver can supply the Heart withall.

So that must needs be, that the Blood which hath once past the Heart, must flow thither again, and from it return again into the Arteries. So that there is a circular motion of the Blood, from the Vena cava into the Heart, from the Heart into the Arteries, from the Arteries into the Veins, out of which it returns again into the Heart, and thence into the Arteries.

Which motion of the Blood was not unknown to the Ancients.

In the Volume of the Works of Hippocrates, The Author of the first Book de *Vitae ratione*, attributes three circular motions to our Heat and Humors, whereby they are moved inward and outward from divers parts.

To Hippocrates in *Forstius Edition* pag. 344.

Truly, I cannot sufficiently wonder, that in so many Ages past, this motion of the Blood hath been unknown, seeing I find sundry, and those no small intimations thereof in the ancient Writers.

Hippocrates in the middle of his Book de *Officium Naturae*, The Veins (under which he comprehends the Arteries) being spread faith he, through

the Body, do cast a function and motion, sending many branches from one. And pag. 277.

this one, whence it hath its original, and where it ends I cannot find. For it keeps in a circular course, so that you can find no beginning, and it will appear plainly to him that examines the place, that he understands this Circle to be chiefly in the distribution of the Humors.

As also in the End of his Book de *Natura humana*. The great Veins do mutually afford nourishment one to another the internal to the external, and then again to the internal.

And more plainly the Author of the Book de *alimento*. There is one beginning of all that nourish, and one end of all, and the same is the beginning and the End: and therefore a little after he subjoins these words: The *Alimentum* comes into the Heart and Nails, and from the inner parts into the outer Surface; from the external parts the nourishment comes from the outer surface to the most inward parts: there is one conflux, one coarctation and one confusus of all.

And Diogenes Apolloniatus seems not to have differed from this Opinion, in Aristotle his 3. de *Historia Animalium* chap. 2. The most thick Blood is sucked by the fleshy parts, and that which redounds into these places, the greater Veins, become thin, hot, and frangible.

To Diogenes Apolloniatus.

The FIGURE Explained.

- AAAA. The Abdomen or Panche of a Dog opened.
- BB. The Midriff.
- CCCC. The Gall turned inside out, towards the Chest, that the inner parts thereof might be more visible.
- DDD. Three lobes or laps of the Liver turned a little to the right hand.
- EE. Certain little portions of the Pancreas which is cut off, that the following Vessels might come into sight.
- FF. The left Kidney covered with its Coat.
- G. The upper hollow part of the Spleen, together with the adjacent Fat.
- H. The middle part of the Spleen, about which Vessels are inserted.
- I. The lowest part of the Spleen.
- KKK. The Guts moved downwards, that the following Vessels might be visible.
- LLL. The Mesentery.
- MM. The splenic Artery.
- N. Part of the Vena splenica annexed to the Trunk of Vena porta, which falls in, upon the Ligature.
- OOO. A portion of the Vena splenica and three branches arising therefrom, which are implanted into the spleen, and do very much swell upon the Ligature.
- PP. The left Mesenterick Artery.
- Q. A portion of the Vena Mesenterica sinistra, next to the Trunk of Vena porta, falling in as empty, upon the Ligature.
- R. The lower part of the Vena Mesenterica sinistra, ready to be divided into three branches, swelling by means of the Ligature.
- SSS. The Mesenterick Veins, therefore more full and swollen, because the Mesenterick Vein is tied.
- TTT. The rest of the Mesentericks, not so swollen, because their Trunk is not tied.

TABLE I.



To Plato. Yea and those things which Plato in his *Timæus* delivers concerning the Blood, are more suitable to this Opinion than the common.

To Aristotle. Aristotle himself may easily be drawn to this Opinion. For thus saith he in his *Book de Somno* chap. 3. Every inability of Sense is not sleep, but that only which is caused by the exhalation of Meats, for that which is vivified, must needs after a sort be lifted up, and afterward return and flow back like as Euripus: for the Heat of every Animal, must needs naturally move upwards, and when it is come aloft, it soon after circulates and descends again.

It is to be feared, that those Writers which followed the former did not sufficiently study the motion of the blood, yea that they obscured the same, because what the former attributed to their Veins, that is to say the Veins and Arteries, these later attributed to the Veins in opposition to, and as distinct from the Arteries. And seeing Galen a most excellent Physician, was not able to reform all things perfectly: and the later Greeks, Arabians, and Latines, have too close followed or transcribed him, hence I suppose it is, that this motion of the blood hath remain'd concealed till this present Age.

Wherein that incomparable Paulus Servita the Venerian, did accurately observe the Fabrick of the Valves in the Veins, which Observation of his that great Anatomist Fabricius ab Aquapendente afterwards published; and out of that constitution of the Valves and other Experiments he collected this motion of the Blood, and asserted the same in an excellent Treatise, which I understand is preserved to this very day amongst the Venerians.

The most learned William Harvey being taught by the foresaid Paulus Servita, did more accurately search into this motion of the Blood, augmented the same with Inventions of his own, proved it strongly, and publish'd it to the World in his own name.

Such hath been the Invention and such the Fate of this motion of the Blood.

And let us now further enquire, whether through all the Veins and Arteries the Blood hath this Motion or whether in some others it hath some other motion? Concerning which thing, that I might be more certainly informed, I contemplated the motion of the Blood in many Veins and Arteries of living Creatures, and I have found, besides what hath been already said of the Veins and Arteries of the Arms and Legs, that the blood is moved through the Spermatick Arteries to the Stones; through the Veins from the Stones to the left Emulgent or Vena cava in the right

Side: through the Mesenterick Arteries, to the Guts: through the Veins to the Ramus mesentericus: through the Celiac Arteries to the Spleen; through the Ramus splenicus of Vena porta forthwith to the Liver: through the branches of the Arteria celiaca, which answer to the following Veins to the Stomach and Gall; through the Gastrick and Epiploick Veins, to the Ramus splenicus: that the short Arterial and Venal Vessels, are branches of the celiac Artery and the Vena splenica, which when they are come unto the middle space, betwixt the Stomach and the Spleen, are divided into two branches: one of which goes to the Stomach, the other to the Spleen; by this branch of the Artery the Blood goes to the Spleen, and by the branch of the Stomach to the Stomach; and by the venal branches to the Trunk of Vena porta, from the Stomach and the Spleen it is moved through the emulgent Arteries to the Vena cava: by the coronal Artery of the Heart into the Vein; out of the coronal vein of the Heart, into the Vena cava: by the

Intercostal Arteries into the Pleura; out of the Pleura by the Veins into the Arterios, and thence into Vena cava. And this I found by binding the Veins and Arteries in live Anatomies; which did swell in that part which did look towards those parts, from which we have shewed the course of Blood to come; and the other parts did not only grow empty but quite settle and fall in. And I was very careful, not to bind an Artery with a Vein, for then the Artery swelling towards the Heart, would have raised the Vein above it, and so it would have seemed that the Vein was filled on both sides the Ligature.

Now in the Head and Neck I saw, and that in a live Goose most easily, and in an Hen, that the jugular being tied, did swell from the Head towards the Ligature, and was emptied from the Ligature towards the Cava, so that it is there also manifest, that the Blood returns from the Head through the Veins into the Heart. But if it should come to the jugular veins I cannot determine, since by reason of the hardness of the Skull, I could not accurately dissect the living Brain, but that the Brain would first die: but credible it is nevertheless, that it flows through the carotick and cervical Arteries unto the four Ventricles of the Brain, for they have passages open to the said Ventricles. For these most learned Men Franciscus Sylvius and Franc. Van der Shagen, have told me, that the fibrous substance being pul'd away which frequently is found congealed in the Veins and Arteries of dead bodies; when it was drawn back in the carotick Artery, it discovered a certain motion, as far as to the third Ventricle of the Brain, and verily, since the blood out of the Ventricles, through the jugular veins, flows back into the Heart, the Ventricles cannot receive it elsewhere, then from the Arteries. But whether the Arteries do shed it immediately into the Ventricles, or into the branches which arise from the Ventricles, is not very easily discerned; because the Arteries, are hardly distinguished from those little branches, seeing the Arteries also have only one Coat in the Brain: but I am apt to believe, that the Arteries empty their blood, into those little branches of the Ventricles, rather then into the Ventricles themselves; because I have observed those vessels which are inserted into the Ventricles to be greatest near the ventricles, as branches are wont to be at their Original.

And thus it is in grown persons; but in the Child in the Womb, the Circulation seems to be somewhat otherwise, and thus I conceive it is. The Blood out of the Mothers Womb, does not go into the Umbilical Arteries, which according to the Observation of Arantius, are not joyned to the Womb; but it enters into the Umbilical Vein, and from thence into the Liver, the Vena cava, and right Ventricle of the Heart; for the Heart beats in the Child though it be imperfect. Out of the right Ventricle it goes into the Vena arteriosa; but because the Lungs do not breathe, and therefore are not opened, they cannot receive the blood plentifully, nor send it to the Arteria venosa; and therefore it goes out of the Vena arteriosa by a peculiar passage into the Aorta, and likewise by a peculiar passage or hole of the Vena cava getting into the Arteria venosa, 'tis poured into the left Earlet of the Heart, and into the left Ventricle thereof. Out of the left Ventricle of the Heart, just as that out of the Vena Arteriosa, it enters into the Arteria Aorta; so that in the Womb-child Nature useth the two Ventricles for one, least in the Child in the womb, which ought to have much but no intense heat; and which must not be dry, the Blood being twice boyled should be burnt, being destitute of the cooling and Fanning action of the Lungs. Out of the Arteria Aorta the Blood goes to the Umbilical Arteries; for they being bound, the part towards the Child, doth pulse and swell: the other part towards the Womb is void of pulsation. Out of the Umbilical Arteries it goes to the Placenta or Womb-case; where the

Arteries are joyned to the Veins by manifest *Anastomoses*, and by those *Anastomoses* the blood entering into the Vein, is again carried through all the forementioned Journey.

It goes out of the Arteries into the Veins. These are the Vessels by which the blood flows from the Heart: But from the Vessel of the Arteries it goes into the Veins after a double manner; first and most usually by *Anastomoses*, by which the Arteries are joyned to the Veins,

which *Anastomoses* are sometimes great and in the greater Vessels as about the Spleen, in the Bladder, in the Womb, in the Womb-liver. And the most accurate *B. Nervus* observes the like *Anastomosis* of the *Arteria Aorta* into the *Vena cava* of the *B. Uly*, but I could never yet be so happy as to finde it in the Body of Man or Beast. And therefore they are not all in the extrem parts of the Body, but some in the middle parts: and therefore we see in a Cripple whose limbs are cut off, the same motion of the blood continued out of the Arteries into the Veins.

And through the Flesh. Secondly it seems also possible that Blood may pass out of the Arteries into the Veins, through the Flesh itself: for we see when a Vein is opened till the colour change, Inflammations fall, because the Blood shed out of the Vessels, is drawn out of the Flesh. But I conceive the passage of the Blood this way is but feldome and in small quantity.

And that motion of the Blood. So that it is now, I conceive, clear, what the motion of the Blood is, and by what waies it is accomplished: it follows that we enquire, what kind of motion it is, and how it is performed.

Is continual.

I have observed that this Motion of the Blood out of the Heart into the Veins, from the Veins into the Heart, is continual never cleaving, nor once stopped or interrupted for a moment of time. And the truth is, seeing the said motion is made, as we shall see anon, because the Heart receives and transmits, and seeing this motion lasts perpetually all the life long, the said motion of the blood, cannot but naturally be continual.

Quick. Also the motion of the Blood is quick, for an Artery or Vein being bound compressed, it immediately swells and grows round and hard: and when the ligature and compresse are taken away, the blood is seen to be swiftly moved.

But how soon the blood performs its Circuit from the Heart and to the Heart again, I cannot precisely determine. We observe it is done sooner by an *Anastomosis* near the Heart, than by one off; nor will I be much against him that shall say the greatest Circuit from the remotest parts of the body is performed in less than a quarter of an hour; for the blood passeth with exceeding celerity. Howbeit it goeth not so swiftly, as we see it leap out when a vein or Artery is opened, because then it is moved in the free and open Air; but within the body it is compressed to lift up its vessels, and to thrust on the foregoing blood.

And therefore we see an Artery being cut open especially if near the heart, is sooner emptied than the heart can supply it with new blood.

But if this be true, why do Feavers not do the *Fita* of return once in a quarter of an hour, *Agues argie* any seeing the *Fit* seems then to happen, when the corrupt matter comes to the heart? whereas now some *fits* come every day, others every third, and some every fourth day. Truly, I will not deny, that it may fall out, that when the Corrupt matter comes to the heart, the *Fit* may happen, as *Huxley* hath an example thereof,

in the 16. chapter of his Book. But I do not think it is necessary for some portion may slip out of the corrupt *Serit*ary, or some sooty stream may arise, and go into the heart and so raise the Feaver, as most Feavers are seen to arise from the Inflammation of the Parts, which the *Imposthume* being opened and the Quitor removed, do cease. And as such kinde of Symptomack Feavers, even so also may sothe intermitting Feavers and Agues happen, by reason of some matter that up, within or without the Vessels, which by putrifying every day, every third day, or every fourth day, regurgitating or fuming into the large Vessels, may bring the *Fit*.

In continual Feavers I confess, whose matter is to stick to the larger vessels, it is harder to shew a reason why there should not be a *Fit* or Exacerbation at every Circuit of the blood. But I conceive I may alledge the same cause which is vulgarly given, why continual Feavers are not allwaies alike seise; because, though the matter be sufficiently near the Heart, yet it doth not cause a *Paroxism* till it have attained a certain degree of putrification: and that the *Fit* lasts so long, till that putrid matter be evacuated, which touches the Heart, or sends its Fumes thereto. But I suppose no man, because of the reason of the return of *Ague-fits*, which is altogether abstruse and unknown, will deny the motion of the blood to be very quick, which is a very manifest thing.

Besides swiftness, the blood hath vehemence in its motion, which appears from what we have said touching the Hardnesse and Tension or stretching, which the Veins and Arteries acquire when they are bound: for nothing can be distended by a liquid Substance into an extrem hardnesse especially upwards, unless it be vehemently driven thereinto or retained therein. But this vehemence, of motion is chiefly near the Heart, removed from which it grows by degrees lesser and lesser, so that the little Arteries in the remote parts, do not pulse, unless some impulse of blood greater than ordinary do happen, as we observe to happen in Feavers, therefore it is that the Veins are not seen to pulse, because the impulse of the Blood is less in them than it is in the smallest Arteries; and because the Veins joyned to the Arteries by *Anastomosis*, when they go from them, divide themselves into more little branches and twigs than the Arteries do, for when Rivers are divided into divers Arms the force of the waters motion is abated. And therefore when some Arms of a Vein are shut, either by something pressing them, as in certain Tumors, or somewhat which stops them, as in the Varices, the blood slipping back by its own weight, the force of the bloods motion is then again observed, and the Veins are seen to pulse: for I have often observed in the Veins which are transparent through the Skin, that most of those palpitations in the parts, which are thought to proceed from Winds, are nothing else but the pulsations of the veins.

And because the motion is more vehement in the Arteries than in the Veins, it seems at first sight to be swifter also in the Arteries than in the Veins just as Men, Horses, and other Animals which move themselves with great labour, and through mistake judged many times to make the greater speed. For the Blood forced through the Arteries cannot all pass through the *Anastomoses*, because it comes out of a wide place into a narrow, and therefore it is accumulated in the Arteries, they are dilated, in which dilation they persist a small time, wherefore in the middle of the dilation and in the whole time of the rest, that same force doth very little further the quickness of the bloods motion, which motion is in the mean time

Nor the Exacerbations of Feavers.

This motion is also vehement.

Not of like vehemence in the Arteries and Veins.

That the same quickness is in the both.

more free in the veins, because it comes out of a strait into a wide place; and is performed by more wayes. Now Reason doth teach us in this Case, that in this motion of blood, the swiftness hereof must be alike in the Arteries and the Veins; for as much blood as the Liver sends to the heart made of new Chyle, and as much nourishment as the Arteries give to the parts, must be repayed, or the Heart will at last be void of all moisture, which thing also sense confirms, for the *Vena cava* pulses so often, in that whole Tract from the Liver to the Jugulum, and therefore drives into the heart, as the Artery is observed to pulse and therefore to receive from the heart. But we shall hereof speak more anon.

Yet of greater quickness when the Heart beats.

Howbeit in the Arteries themselves, the blood is moved more nimbly when the Heart drives it; from which Quickness it departs by little and little, when the Heart begins to rest and is afterwards dilated. Yea and in the Veins themselves, the motion of blood is more vehement and quick when the Heart pulses; which as we have observed in live Anatomies, so have we often noted the same, when a Vein hath been opened in the Arm, in which the Veins were not much distended with the Ligature. Also the foresaid palpitations of the Veins, seem to proceed from no other cause then that the Veins being strained by the Blood sliding back, or by some other means, when the blood cannot by its force make it self way, it lifts the Vein up, which falls again, when that forcible endeavour is abated or the Vein gives a freer passage to the Blood flowing through the same.

One portion of blood doth not always go the same way.

But I do not conceive that the blood which is once carried, for examples sake to crural Veins, is continually carried the same wayes, but that when it is returned to the Heart, it is mixt with that blood which comes out of other parts, and is so promiscuously distributed to the parts of the Body: for so the parts may be the better nourished, if they have alwayes new blood, out of which they may draw, that which may best serve to nourish and strengthen them: so Plants do best grow, when they are transplanted into new Soils.

The Vital Spirits are mixed with the Blood.

The Animal Spirits motion through the Nerves cannot be observed.

This is the whole Manner of the Bloods motion: and also of the motion of the Vital Spirits, seeing they are mingled with the Blood.

But the motion of the Chylus easily through the milkie Veins.

What kind of motion that is.

I have often endeavoured to search out the motion of the Animal Spirits, but I could not else-where observe it save in the Muscles, which seemed to them to be distended broadwayes and deepwayes, and being cut asunder to tremble and pant. For the Nerves being bound neither swell nor are they extended, and being cut in sunder they shew no other motion, save that they contract themselves. And it is a very easie matter to bind the Nerves of the sixt pair, which freely wander through the Chest.

But the motion of the Chyle through the milkie Veins, is most manifest. Now it is not so continual as that of the Blood, because there is not alwayes a supply of Chylus. And when it wanders out of the Guts through the milkie Veins, it goes quicker than the Blood it self, and the Veins being bound do swell immediately. And therefore they do not long appear in live Anatomies, nor are they found in dead Carcasses; unless some obstacle do hinder the motion of the Chyle. And in that being bound they do not so swell as to grow hard, it seems to be a Sign that the motion of the Chyle, is not

so vehement as that of the Blood: peradventure because the Chyle is to be moved through a smaller space, the violence of motion was not requisite.

But it is now time to enquire into *The Cause of the the Causes of these motions*, and first of *Blood's motion*.

Whatever the Cause is, either it must be moved by an inbred vertue or faculty, or by some motion which must be referred to carrying, drawing, or thrusting.

That the Blood is moved in this manner by its own proper Vertue, we cannot observe, either from the Blood received in a Basin or shed into the body, which that it should be in a moment corrupted is hard to say: nor can we see such a spontaneous motion in any inanimate thing. And whereas Harvey relates Chy.

4. that when the Earlet was still, he observed the motion of the Blood; I likewise have observed the same, and likewise when the Heart was quiet; but withall, that motion was imparted to the Blood from the *Vena cava*, and that in the Heart from the Earlet, as we shall see anon.

That the Blood is here carried by the Spirits cannot by any Argument be proved: and they by their lightness should move the Blood upwards, which we see here to be moved downwards and sideways.

And therefore it remains that either the blood must be drawn or thrust.

That the blood is thrust forwards, Men of excellent wits do conceive, because the Hearts heat immeasurably rarifying the same, it requires a greater place, and that therefore it dilates and lifts up the Heart; and seeing it cannot be contained in the dilated Heart, it is poured with such violence into the *Vena Arteriosa*, and the Arteria Aorta, that it distends all the Arteries and makes them pulse. And they bring this Argument for their Opinion, that the Heart of an Eel or any other Animal when it leaves pulsing, if it be warmed by Fire held under it, it is seen to pulse again. But whether may not that pulse happen, because the Spirit being by that heat made more lusty, can better assist that cause which moves the pulse in the Heart; just as, when the Guts and Muscles are heated in a live Dissection, in which nevertheless there is no ebullition, the motion seems to be restored. For there is indeed only a certain light

Rarification proceeding from a certain warmth in the Heart; no ebullition or sudden diffusion. And truly I have often seen in strong Dogs, that the Blood doth not leap out of the Heart by reason of Rarification; when the Heart the tip being cut off; when through the Efflux of blood it was not half filled, being set upright, it was not filled by rarification: but the Constriction following, that portion of blood which was left in the Heart, was spirted out above four Footes distance, so that my self and others by me (for many were present) were bespattered therewith, whence it is manifest, that the blood is driven by the part.

It is also driven because the blood being so changed, is troublesome to the Heart and those parts. For if the whole Heart, or the tip thereof living and distended, or other greater particle, be pricked with a Pen-knife or a Pin; as often as it is pricked, so often it will move it self as by Natural motion, though it seem long ago to have lost all motion.

And that the Blood is driven by the *Vena cava* into the right Earlet of the by the *Vena cava* Heart, I have manifestly seen in the dissection of live Creatures: for in all motions of the Heart, the first beginning of Motion is so or no, because the Cava was knit to the Earlet and the Heart, we saw the Heart and the Earlet quite off in live Dogs, at the *Vena cava*, and we observe, that even then

the *Vena cava* did a very little pulse, and at every time did send forth a little Blood. And therefore the *Vena cava* hath certain fleshy fibres, for the most part, about the Heart, which elsewhere you shall not find in the *Venae cavae*: but they may be seen very evidently in the *Vena cava* of a Man, an Ox, a Dog. Now the motion of the *Venae cavae* is most evident near the Heart, yet for the most part I have observed it also in live Dogs, all along that passage from the Liver and from the Jugulum, as far as to the Heart.

Of it is it into the Heart. The right Earlet drives that Blood which it receives, by a certain tension and constriction into the right Ventricle of the Heart: for also in the Earlet the motion or constriction is a little sooner than it is in the Heart. And the right Ventricle of the Heart being cut open as far as to the Earlet, at every constriction there manifestly appeared somewhat to be drawn out of the Earlet into the Heart, which also *Harvey* observes in his fourth Chapter.

Yet is it drawn also? So that the Blood comes chiefly by pulsion, into the right Ventricle of the Heart. But is it not also drawn both into the Earlet, and the right Ventricle? I conceive so: for with part of that Blood which they receive, they ought to be nourished withal: now that which must nourish, must be drawn, to the end the part may receive that Blood which is most useful to it; for by pulsion also that which is unprofitable is sent away, as *Galen* excellently (according to his wonted manner in other Cases) doth infer in his 1, 2, and 3. Books de Nat. fac. Now this drawing is not only of that blood which is near, but also of that which is far off, as all parts have that faculty, least they should be soon destitute of nourishment.

But doth not the Heart also draw, because it is widened, to avoid Vacuum, as we are wont to say? It is not likely, because in its dilatation there can be no fear of Vacuum, as shall hereafter more evidently appear.

The cause of the motion into the left Ventricle is the same. As the Blood comes to the right Ventricle of the Heart, so also it comes to the left, save that we could not observe the impulse of the Blood, when the Lungs fall, to be so strong out of the Arteria Venosa, into the left Earlet, as out of the Venacava; yet there is manifestly some. And the impulse into both Earlets and into both the Ventricles, happens at one and the same moment of time: save in Creatures ready to dye, in which we have observed, that both Earlets and both Ventricles do not pulse at one and the same time.

But when the Blood is thus driven into the Ventricles of the Heart, the Heart hath no motion evident to the Eye, but putting our Finger upon the Heart, we perceive somewhat to enter into the Heart, and that the Heart becomes fuller, which also *Harvey* hath observed, in his 2. Chapter. Yet we have observed that the Earlet hath pulsed seventy, sometimes an hundred pulses, before any motion of the Heart followed.

So that we see how the Blood is moved into the Heart: Let us now see how it is moved into the Arteries.

The Blood is drawn either by way of pulsion, or driving: out of the Heart into forsooth a hole being made in the Arteries when the Heart, we saw Blood come forth, Heart is contracted. When the Heart contracted it self, also the Aorta or Vena Arteriosa being cut off from the Heart, we saw Blood poured forth when the Heart did straiten it self: the tip of the Heart being cut off and the Heart set upright, we saw the Blood expelled and leaping out of the Heart; the Heart being cut a thwart in the middle, we saw the Blood expelled in the Systole, but we never saw it go out in the Diastole. And whereas some say they have seen in live Dissections

the Blood come out in the Diastole, I conceive they were deceived, by taking that to be a Diastole, which is indeed the Systole, which also that same Anatomist Columbus observed in his 14. Book de Re Anatomica.

For in the motion of the Heart, we must exactly distinguish betwixt the Constriction, Quies, and Dilatation thereof.

In the Constriction or Systole of the Heart, the point of the Heart draws near to the Basis, and therefore it becomes a little broader. And in this

The Cause of the Constriction of the Heart.

Animals in which the Aorta is inserted not into the Basis of the Heart, but a little towards the middle, as in Rabbits, Eels and such like, the Basis also of the Heart draws towards the point. Now the sides of the Heart, seated against the right and left Ribs, do come one nearer to another, so that if you shall cut off the tip of either side, so that it may hang, in the constriction it will return unto the sound side and as it wete into its place. But the side of the Heart against the Breast-bone, is lifted up, and especially towards the Basis: and so the whole Heart is bent and stretched on all sides, and that part near the Basis being lift up, seems most of all to smite the breast, and to make that beating which we feel; although the point also may do it, which that great Anatomist *Kieser* observed, in the sixth Book of his *Anthropologia* Chapter, 12.

And that I might be the better assured, that this motion of the Heart now described, is the Constriction thereof. I have sometimes cut off the tip of the Heart, and sometimes cut it slender athwart through the middle; And I manifestly saw, when it made the foresaid motion, that the Cavity of the Ventricles became less, and my Finger being put into the hole, I felt the Ventricles contract themselves to my Finger. And the self same motion which I have shewed in the Heart makes externally when it contracts it self, it shews also inwardly; save that there seems to be no motion in the Septum intermedium: peradventure, least the Septum to straiten the left Ventricle, should come nearest the left side of the Heart, it should leave the right Ventricle wider.

This is the Tension and Constriction of the Heart, whereby the Blood is forced out of the Ventricles of the Heart, into the Vena Arteriosa and the Aorta. And when it is lengthening, it is made only by the help of those fibres wherewith the flesh of the Heart is furnished; but to make a stronger constriction, those greater fibres concur, which are seen in the Ventricles of the Heart, as I have often observed, in Dissecting the Ventricles of the Heart in live Anatomies.

Now those fibres in the Ventricles and in the substance of the Heart it self, do manifestly cause the Constriction, because they are on all sides distended broadwise, and therefore they are abbreviated as to length; just as all the muscular parts of our Body, do in like manner perform their motion: and therefore when we would chew our meat we feel our temporal Muscle swell and grow hard. By reason of this swelling the Cavity of the Ventricles of the Heart, is made more strait. And this Tumor of the Flesh and greater fibres begins at the Basis, and proceeds gradually unto the tip. In regard of which Motion if *Hippocrates* in the Beginning of his Book de Corde, call the Heart a strong Muscle, he did truly after an elegant manner express the manner of its Motion.

When the Heart by its Constriction hath forced the Blood into the Arteries, it returns to its Natural state. For the point returns from the Basis, as also the Basis from the point, in those Animals which have no passage into the Aorta, in their basis; but the left and right side of the Heart, extends it self towards the Ribs, and that side which looks towards the Breast-bone falls in, especially

The Heart after its Constriction returns to its Natural state.

there where it answers to the Orifice of the Aorta, and then the whole Heart rests, and is found loose and soft.

And unless that upper side did settle and fall in, the Heart would be dilated in this return hereof to its naturall state, as is easie to see and feel, when the heart is dissected. But that upper side must needs fall in, least the heart being emptied by foregoing constriction should admit a Vacuum. But when out of Vena Cava and the Arteria Venosa, new blood is forced into the heart, and the Blood contained therein is rarified by heat, then the

upper side rises: and the other sides, as we said before, remain extended. And so the heart is then in its dilatation; nor is there any other dilatation of the heart save this, to be observed.

In the Particles of a live heart dissected and taken out of the Bodie, there is no other dilatation then a remission or slackening from Constriction. Indeed in those particles where constriction is ceased, there remains a feeling kind of Palpitation; but, that is another kind of motion proceeding from the spirit contained in the flesh and seeking its way out; such as may also frequently be seen in the muscles whole or dissected, in Creatures dissected presently upon their death.

So that the Dilatation and Constriction of the heart happens after the same manner as that of other parts, the Stomach, Guts, Bladder, Womb, which are distended by what is sent into them, which when they have voided, they return to their naturall state.

Now we cannot better observe this motion of the Heart, then in those Beasts which have only one ventricle in their Hearts, or if they have two, when the Animals begin to languish, otherwise when the Creatures are strong, the motion is hardly discerned because of its Swiftnes; also because the two ventricles present those motions doubled; and because the Cone of the right ventricle, seeing it is less high then the left, when it is drawn back to the Basis, it makes an oblique motion.

But let us return to our business, and let us see further how the blood out of the Arteries near the Heart, is spread through the Arteries of the whole Body, now it is done by a manifest Impulse or driving or any

Artery being bound, at the Ligature it swells very much, and is stretched to an extreme hardness.

Notwithstanding the Heaviness of the Blood furthers its motion downwards, and therefore the Heart seems to have been placed nearer the Head then the Heels.

It is also likely that the Blood is drawn into all the Arteries, to the end that they and their neighbouring parts may be nourished with convenient Blood.

But that the Arteries should draw by being widened, there seems no necessity: for the Blood may be driven forward only by impulse, and the Arteries may drive the same: for an Artery being broke and an Aneurisma made in the Flesh, the Aneurisma in the flesh, is perceived to pulse after the same manner as the Artery; wherein manifestly the flesh doth not draw the blood by dilatation, but the blood is driven into the same. A miserable example whereof we lately saw in the most expert Dr. Johannes Elemannus, in whom an Artery breaking, the Aneurisma possessed a fourth part of his Chest. And the like was observed by Riolanus in the 6. Book of his Anshropologia chap. 12. And that indeed the pulse of the arteries is caused by the Impulse of Blood, the waving, creeping, pismire pulses seem to shew, and many others which manifestly imitate the motion of the Blood in the artery.

True it is indeed, in that Book of Galen whether blood be contained in the Arteries, in the last words it is asserted.

that an hollow Reed being thrust into the arteries, and the artery tied above the Reed, the artery doth not pulse beyond the ligature, though the blood may be driven through the Reed. But I suspect that place is maimed and wants somewhat, because after the manner there described, the operation can very rarely and hardly succeed: for a free artery is there prescribed to be opened out of which when it is open, every body knows what a world of blood leaps out, so that either the Creature will die, or through its weakness, no arteries at least not those more remote can pulse.

But suppose the place is perfect, and that the operation shall succeed as it is there described, it may happen that the Creature quite languishing because of the flux of Blood, the pulse might be felt on this side the Reed, because the Reed being thrust in, rendering the artery more narrow, might in part stop the blood, so that it might easily fill the artery and lift it up. So I have many times seen, arteries which shewed either a languishing or no pulse, manifestly pulsing, when they were compressed not very far from the Heart. But Galen observed no pulse beyond the Reed, because through the Reed much narrower than the artery, the artery received little blood. And that such a thing might easily happen, I have observed in a Rabbit, into the Aorta whereof, it being tied on each side we thrust a little Reed, but because the ligature being loosed the Beast died, we thought it not worth the while to bind the artery above the Reed and we thought we saw some pulse as far as to the Reed, but we could perceive none beyond the Reed.

Moreover we could never make that experiment succeed, because it is not easie to find a convenient Artery, and when it is found and duly opened, the Creature most speedily dies, either because of Bloodshed, or (which may seem strange) by Convulsions.

So that we can see no other, but that the Blood being forced may pass through the Arteries, and that by it also the Arteries may be distended, nor seems it necessary to call any other Cause to make the Arteries pulse, seeing

the forealleaged Cause may suffice. Yet Nature is wont frequently to call more assistances to the performance of her works then do indeed to us seem necessary, who cannot alwaies dive into her Secrets. So here, some tokens are observed by Galen, that besides that dilatation they receive from the impulse of the Blood, the Arteries do also endeavor their own dilatation. That all the Arteries of the body both in found persons and Creatures, and in live Anatomies, do pulse in one and the same moment: but nothing that is moved to distance, can be every where at one moment; and therefore not at the same moment make distention every where. The Guts when blown up by Anatomists, or Pudding-makers, are seen to be distended in the parts neer the Blower first, before the remoter parts are distended. True indeed it is, that the Arteries are not empty as the Guts, but they are distended being partly filled with blood: yet, seeing that blood which comes out of the Heart must thrust forward that which is next it, and thus again that which is next it, and so forward untill the Arteries be filled and distended every where, it doth not seem, though the motion be performed out of a wide into a narrow place, that it can be performed in one moment. just as we see twenty stones which the Boys set in a row, the greatest first; when the first is beaten down, all the rest do not fall in one moment. And therefore we may suspect, that the Diastole of the Arteries, is caused by the impulse of blood, and by their own proper dilatation: and that both these causes contribute to the Bloods motion.

Hence also it appears, that this same impulse of the Blood is made only by the

Yet Galen hath certain tokens that the dilatation of the Arteries helps their motion.

De usu puls. cap. 5. An sanguis in Ar. c. 8.

But the impulse is here caused only by the Heart.

R r r

the Heart, nor does one part of the Arteries drive it into another: for that part which drives by constriction, that cannot in the same moment be dilated, but all the Arteries are dilated in a moment.

Out of the Arteries into the Veins, out of the smaller Veins into the greater. And thus the blood is moved through the Arteries; and out of the Arteries into the Veins, out of the lesser Veins into the greater and the Vena cava it self, the blood is moved also by Impulse. For any Vein being bound in living Creatures, it falls in, and

growes lank towards the Heart, and it is filled in that part which is more remote from the Heart,

It is driven. And this same Pulsion to the Heart, seems to happen from any part of a Vein, for a Vein bound or compressed in a living Arm it is not only stretched in the part remoter from the Heart, but also in the rest thereof nearer the Heart it falls in and is emptied; which nearer part if you also tie that also will be distended beyond the Ligature, and will swell. Now this Pulsion is caused by the Fibres whereof the Veins are constituted.

And drawn. We conceive nevertheless that the veins do also draw, least they should receive the blood without choice, and that they may draw to themselves that which is most useful: howbeit they seem to receive the blood more by Pulsion then by traction or drawing, because the veins being bound, are wonderfully distended.

In the Vena cava there is a certain Store-house of Blood, wherein blood is treasured up for future Uses, when it is more plentiful then that all of it need be sent unto the Heart.

So also by Pulsion the Chyle is moved out of the Stomach. And all these are Causes of the Natural motion of the blood. To which the causes of the motion of the Chyle, are not unlike: for the Stomach contracting it self by its Fibres, squeezes out as much Chyle as is digested, And by that pressure it seems also to open the Pylorus: for there seems not to be any spontaneous motion in the Pylorus, such as is in the Stomach or the Guts.

Through the Guts. The Chyle sties not long in the Guts, but is presently driven out by the constriction of the transverse Fibres: and while many fibres, and which mutually follow one another, do act, the Chyle is pressed, nor can it all slip downwards, whereupon some of the pressed chyle slips into the milkie Veins; yet least that the Chylus should slip too soon to the Fundament, it is stopped by the constriction of the lower transverse Fibre: and being thus shut, and compressed above and beneath, it is pressed through the wrinkled Coat of the Gut, as it were through a strainer into the milkie Veins. Now this same constriction of the transverse Fibres, happens in all the thin or small Guts, and in all the thick or round Guts, in a certain order, and at certain distances of time.

By the milkie Veins. That the Chyle is moved through the milkie Veins into the Veins of the Portæ, into the Liver, and sometimes also into the Vena cava by pulse, a Ligature does shew.

And also drawn. It is also likely that Chyle is drawn out of the Guts and milkie Veins, for it is moved more swiftly out of them, then the Guts or Vena lactææ do seem to drive or force the same.

The Chylus in the Ramus mesentericus, Vena portæ and Vena cava, being mingled with the blood, is moved by the same cause, which there as we have said, does move the blood.

Now the Chylus is carried by peculiar Veins, rather then by the Mesaraicks which contain blood, because the Mesaraicks being to admit blood, were to have their mouths opened into the Guts, through which the blood would easily have slipped into the Guts. Nor could the drawing Faculty prevent that inconveniency, which is here much obfurer and much weaker then the expulsive Faculty.

As this Motion of the Chylus, so also the circular motion of the blood hath its uses and conveniences, of which the principal seem to be these.

That by the continual passage thereof through the Heart, the blood is also continually heated, and whiles some blood goes through seldom, other blood oftner, there is found in the Veins blood of all Qualities: which while it is carried into all parts, and Nature unlocks, and offers all the treasure to them, they may be the better heated, and receive that Nourishment, which may be most convenient to feed and strengthen them.

But this motion does also contribute much to the preservation of the blood in its integrity, free from corruption or putrefaction: for

Vitium capiunt, ni moveantur aquæ.

Unstirred waters easily corrupt.

which is also most true of the blood, as we may daily see when the Vessels are obstructed.

It contributes also to the perfection of the Blood, whilest by continual motion, it is rarified and attenuated. But it makes chiefly towards it perfection, in that the blood is sometimes attenuated, grows hot, and is rarified in the Heart, and sometimes again it is condensed and congeals as it were in the Habit of the Body. For no part in the Body is hotter then the Heart, and none less hot then the Habit of the Body. And therefore there happens a certain Circulation as it were, not unlike to that whereby the Chymists make their Spirits most subtile and perfect. For the blood which is attenuated by heat, after it is condensed by cold, is able to persist in that thinness, nor does it return to its old thickness: from which degree of thinness in tract of time it attains to a greater by means of heat, in which being again condensed by cold, it comes to continue; and so at last it becomes most fit for the making of vital Spirits.

For this end the blood is moved circularly; but hath it not therefore elsewhere another motion? Out of the smallest Arteries the blood is carried right out into the flesh, that it may constitute the nameless humor, the Ros, Gluten, and Cambium, nor does it return hither from whence it came, least the blood flowing through the least, should hinder these humors from being gleued and assimilated to the parts.

It flows also sometimes chiefly, because it is driven out of the Arteries into the flesh: and frequently also the chief moving cause is attraction: for the bones cannot without attraction receive the thicker part of the humor for their nourishment, and leave the remaining thinner part thereof, unfit to nourish them in the Vessels.

Why not through the mesaraick Veins.

The motion of the blood serves for the utility of the parts.

And that it may be preserved.

And to perfect the Blood.

The blood which is carried to nourish the part, is not moved circularly.

The FIGURE Explained,

TABLE, III.

AAAA. The vulgar mesaraick Vein and Arteries, derived from the Gate-vein called Porta.

BBBB. The milkie Veins discovered by Asellius.

C. The Glandule or Kernel in the Centre of the Mesentery which Asellius calls the Pancreas or Sweetbread, to which all the Branches of the milkie Veins do go.

DD. Two milkie Branches greater then the rest, ascending by the Porta, and inserted into the Liver by the Opinion of Asellius.

EE. The Lobes of the Liver.

F. The Gall.

GG. The empty Gut called Jejunum.

HH. The Ilium.

OO. Glandulous Flesh in Dogs, by the Duodenum and the Entrance of the Jejunum, which may be called in Dogs, the lower part of the Pancreas.



Nor is there any other motion of the Blood, whereby the Valves of the Heart are shut.

Some also there are who suppose, that the blood being carried out of the Heart does go back, and return again by the Arteries into the Heart. Which they are therefore moved to think, that they may be able to give a mechanick cause, why the Valves of the Heart in the Office of the Arteries, do fall down and are closed up. I truly have alwaies esteem'd that a rare design of Erasistratus, to explain all things that happen in our Body mechanically, but I account it a rash thing in him to measure the Wisdom of God by his own Wisdom. And these are to be counted Engines, which evident reason, and especially Sense do shew to be such. Here contrariwise our Senses observe, that the blood goes through the Arteries from the Heart not to the Heart; and in a rare and languishing Pulse, that the Artery does not swell last, where it is knit to the Heart, as it should do if that Opinion were true, but first of all. Also that the Valves are not shut by the blood running back, we have this sign, that in case the Artery be bound two fingers from the Heart, and it be so opened betwixt the Ligature and the Valves, that the blood may freely pass forth, and therefore go neither backwards nor forwards; yet the Valves may be divers times well fastned, the Heart ordinarily moved, and so as not to send forth the blood, save in its constriction. And therefore if I would here allow of any mechanical Motion, I should admit the common Opinion, which saies, that the shutting, as of the heart, so of the Valves, is performed by contraction of the Fibres. For that same contraction of the fibres in the Heart, is every where obvious to the Eye-sight.

But we have truly no sign or token that the Blood is any other waies directly moved through the Veins from the Heart, or through the Arteries to the Heart. In Joy, truly, the Humors move outwards; but this may be betide by the Arteries alone. And in Sadness, the Humors may be moved inwardly through the Veins alone; and they must needs do so, for seeing the Pulse does not cease in Sadness, and by the Pulse there goes continually somewhat through the Arteries outwards, hardly can any thing be moved through the Arteries inwards, and to the Heart.

Howbeit, praternaturally the humors have another motion besides that which we have here described, whilst by their lightness or other activity, they mount upwards, or by their weight descend downwards, as is manifest in such as have the Varices so called. Also that way being shut up, by which they were wont to be moved, they are compelled to seek another. So in a Duck I have divers times seen in the Vessels of the Breast, the blood parti-coloured, some whiteish, some reddish, which the Artery being contracted, was moved to and from the Heart, in divers sides of the Artery:

Nor in Passion of the Mind.

Yet there is another praternatural motion thereof.

ry:

ry : but that motion lasted not long, nor did the blood ever enter into the Heart by that motion.

And thus (most worthy Friend *Bartholine*) I conceive I have answered your Question touching the motion of the Blood. Whereinto I did enquire more scrupulously, that I might better know the Nature of the Humors, and their Deflux : from which Flux of Humors innumerable Diseases arise. I did also believe that I might more exactly understand how good or bad blood was generated, if I knew those Parts by which the Humor passing along might be changed. Also I conceived that I should be better able to judge, how very many Diseases ought to be cured, if I knew which Vein being opened, would evacuate such and such parts, and through what parts the Remedy ought to pass, before it can come to the part affected : Also innumerable things came into my mind, diffused through our whole Art, as the Doctrine of Pulses, of Feavers, of Inflammations, their Generation and Cure, and other things, which made me desire to be acquainted with this Motion of Blood.

And the Experiments whereby I was brought into this Opinion, are so evident, that I doubt not to affirm, that learned and discrete Physicians will hence forwards, allow of this Motion of the Chyle and Blood : Howbeit in some Causes and in certain circumstances of this Motion, I cannot promise the like Agreement : for sundry men are Naturally inclined by a disparity of their Judgments, to embrace different Opinions.

Touching the truth of these Experiments, you cannot (my *Bartholine*) make Question, who have your self seen many of them : and there were frequently present most learned Doctors of Physick not unknown to you, *Franciscus Sylvius*, *Johannes Van Horn*, *Abasius Schmitternus* most accurate Dissectors ; and those persons of solid Learning *Franciscus vander Schagen*, and *Antonius Voeslaart* : nor were they only present, but they also afforded their Counsels and Handiwork to help make the said Experiments : to whom in that respect I am very much obliged. And so farewell most learned *Bartholine*, and persist to love me. Dated at *Leyden* the 10. of the Kalends of *October*, Anno 1640.

THE SECOND LETTER OF THE Motion of the Blood, To the said BARTHOLINUS.

Such is the Fate of Writers, that they are compelled to write when they are unwilling : that so they may answer their Adversaries, unless they would rather be wanting to themselves, or the cause which they defend. A certain learned Man would needs extort this from me, being busied about far other matters. For those Theſes which he had before objected against, he hath endeavored now lately by a peculiar Writing to refute. In which Writing there are many witty and learned Passages : but I find that fault in the Author, which the Ancients found in *Albucius* the Rhetorician, who made it his Business in every Cause he pleaded, not to say all that should be said, but all that he was able to say. Also that Motion of the Blood which is evident in live Dissections, he hath never labored to observe : just as if the matter might better be conceived by the Mind, then he could see it with his

*The occasion
of this second
Letter.*

*Answer to the
Objections.*

Eyes. But these and other things concerning those Theſes, I leave to the Care of *Roger Drak* who is now a Doctor of Physick at *London*, a Man of an

acute Wit and solid Learning : I shall only meddle with such things as shall seem to oppose the circular Motion of Blood. And in the first place, what it is that Blood-letting does teach us in this Case, concerning which that learned Man hath observed things worthy of Consideration.

A Surgeon being to open a Vein, makes a Ligature upon the Arm, that the Vein may swell. The Vein that swells, not on that side the Ligature towards the heart, but on that side the Ligature, which is furthest from the Heart. Now the Cause of that Tumor is not Pain, caused by binding the part : for oftentimes little, and commonly no pain in the part bound. And when the Arm is pinched or pained by Burning or otherwise, it hath its Veins for the most part less swollen, then upon a simple and bare Ligature.

Nor is it more likely, that the Veins swell upon the Ligature, because through the Veins which are straiter because they are bound, greater plenty of Blood comes and with more swiftness from the Liver ; as about Bridges and in other places, Rivers being straitened do run more swiftly. For the Water of a River being ga-

*That in Blood
letting the Vein
does swell at the
binding.*

*Not through
Pain.*

*Not by strain-
ing the Vein ;*

there'd

thor'd together in a narrow place, is manifestly lifted up into a swelling, from which when it falls, it goes the faster: but the arm being bound the contrary happens; for they are not the Veins nearest the Liver, from which blood should come, but those farthest from the Liver which are most distended.

It remains therefore, that the Veins *But because the* swell beyond the Ligature, because *motion of the* the motion of the blood running from *Blood is stopped.* the small veins into the Heart, is stopped by the Ligature, and being there gathered together, distends the Vein. But to the end I might be more certain hereof, I bound the jugular and crural branch, in living Creatures very strongly with a thread, so that no blood might pass by; and I opened that part of the Vein which was more remote from the Heart, it bled plentifully, swiftly, vehemently, soon after I loosed the band, and cut the Vein asunder through the middle, and the part thereof farthest from the Heart being drawn out of the body upwards, presently and swiftly fell a bleeding: whilst in the meantime the part of the Vein nearest the heart, being somewhat elevated, least the Creature struggling with pain should easily force out the Blood; first it voided but little; and afterwards no blood at all, whence it seemed to me apparent, that the blood came out of the veins far from the heart, into those near the same, and not out of the greater Veins into the lesser; unless haply some neighbouring blood finding a way might slip away. Any one may easily try as much in opening a vein in the Arm: for if he force the blood above the Ligature upwards with his finger, so that the vein appear empty, yet shall he see the blood issue out as fast as ever below the Ligature; which could not come through the upper branch being at present empty.

But if the Vein be thus distended with *Nor doe the* blood, which is moved from the smaller *Arteries swell* veins to the Heart, how can the artery *because of the* be distended upon the ligature, which *Ligature.* divers excellent Physicians relate to have been so distended, that it has been opened instead of a vein; the truth is, the Artery doth not swell upon the Ligatures being made, unless where it is nearer the Heart, but farther off it falls in somewhat, and is diminished, as I have an hundred times and oftener experimented in the Dissections of living Anatomies. But I do not think it was any of the authors, meaning that the remoter part of the Artery was distended by means of the Ligature, but that their meaning only was, where the Vein did not appear which was to be opened, that there the place where it lay was to be sought by feeling; and that by a pit, by motion and swelling of the Blood it was to be found: and when we feel a swelling, or otherwise discover the same, we should not presently conclude that there was the Vein; for it might be an Artery which by reason of the hard binding had lost its pulse, and which by reason of the thickness of the Coates not quite falling in, might counterfeit a certain tumor and puffing-up as it were.

But moreover if the Vein swells by *But the Veins* reason of the Blood returning to the *swell also with* Heart, why does the vein also swell and *two Ligatures,* if opened, why void Blood, when *and therefore.* there is a Ligature made below as well as above the place phlebotomized? which Blood cannot be thought possibly to come from the lower parts, by reason of the Ligature made below the Orifice. But this does not alwayes so happen, but

but sometimes, only when the Arm is tied at a certain distance, and then the greater Veins in the place between those two Ligatures do receive that blood from the smaller Veins, which smaller Veins receive from the smaller Arteries, which are joyned to the final veins by way of Anastomosis. And that indeed the blood which flows out betwixt the two Ligatures, does come by way of Anastomosis out of the Arteries, this is a sign and in that it flows more hotter and with more violence, and more easie and sooner a Lipochymia or fainting fit follows the efflux hereof. And this Ligature I am wont to make use of, when I have signs that spirituous and hot blood is in fault, and I bid the Chirurgion seek out those Anastomoses, by his Ligature: for if the Ligature be made above the Anastomosis, it stops the motion of the blood; but beneath it does not stop it, but the blood leaps out hotter to the feeling of the Patient.

When a Vein is opened and the *Why in blood-* blood runs out, as soon as it begins to *letting they un-* stop or come away sparingly, or if it *bind the Arm,* did so at first, we loose the Ligature, *when the blood* that the blood might run out faster. *does not run a-* Now the Ligature seems not therefore *pace.* to be slack'd, to the intent the blood may come from the Liver through the Veins. For though there be little or no blood above the Ligature, yea only a pit appear in the Vein, yet will the course of the Blood be increased by loosening the Ligature, which cannot possibly come out of an empty Vein. But by the loosening of the band, the Blood may the better descend by the Arteries, and pass out of them into the Veins; because the Arteries being compressed by the Ligature, by loosening the said Ligature become more free. Now that the Arteries are not alwayes sufficiently at liberty when the arm is bound, the patient himself can witness, who oft perceives the pulse of the Arterie at the Ligature, which perception the compressed Arterie causes, when it smites against the flesh. And the Physician if he examine the matter, shall often find a less pulse in the bound arm than in the free. And I can testify that I have divers times applied my fingers to the Patients wrist, when the band was to be loosed, and observed, that when by loosening the Ligature Blood came in more plentifully, the Pulse became greater.

But if that Blood which flows *Why much blood* out when a vein is opened, comes *may be taken away* out of the Arteries into the veins, how can it be plentifully taken away? for all the Arteries pulse equally, and therefore they seem to afford blood to the Veins in one and the same measure; and if so be the rest of the arteries afford so much to their veins as the arteries of the Arms do to theirs and is drawn out, shall not the heart be soon destitute of all blood? There is truly no danger at all: For we have said the blood comes as fast unto the heart, as it is driven thence.

Yet I cannot conceive the Blood enters all veins alike, although the Arteries seem to pulse equally; for all Liquors flow more easily and swiftly into an empty place, in which there is nothing to drive and force them, and moreover in this case the Blood is more forcibly drawn by the empty Veins then by the full ones.

Now more store of Blood issues from a vein opened in the cubit, then in the Hand, because all that blood, which comes to the Veins through all the Anastomoses of the Cubit of the Hand, must return through the Cubit Veins; *And more out of the* *Arm then out of the* *Hand.*

but less runs through the Veins of the Hand, and that only, which comes through the Anastomoses of the Hand.

Why it flows out of a wounded Arterie not bound. Out of a wounded Arterie, indeed the blood presently flows, although it be not bound. But that happens because the Blood is carried with greater vehemence, though the Arteries then through the Veins; by which vehemency, it fills the Arterie, lifts up and distends the Coat, and if it be opened, necessarily flies out.

The Ligature being loosened, the blood stops, and sometimes it runs, and why? Out of a Vein opened when Blood has flowed sufficiently, we stop it by untying the Ligature, because the Blood may be carried again its old way, now it is at Liberty and the way free. But if it

so happen, that too much blood being gathered about the Ligature, the Veins cannot give it a free passage; or so large an orifice be made, that the Blood may now go right out that way, by which it went, when it was shut in, sometimes the Band being loosened, the blood runs out in a full stream.

Which our Chyrurgeons at this very day, that they may effectually stop, they frequently compress the vein

But is stopped by holding the finger in the Vein below the Orifice. with their Thumbs a little below the Orifice, and so they stop the blood; least if they should compress it above the orifice, the blood contained therein should presently curdle, and hinder the healing up of the Vein. And they that deny that the blood may thus be stopped, I know not wherein we should credit them who would abuse us in a thing obvious to the Senses. And seeing the Blood is stopped by compressing the lower part of the Vein, it is truly manifest that the Blood ascends from the lower parts.

But in case it should happen, not in Blood-letting, but by some other mischance, that a Vein should be so wounded, that the Blood could not be stopped, the Vein is cut asunder in the midst: Whereupon, the

Also when the Vein is cut asunder in the middle and wherefore, Vein being no longer stretched out as before, the parts cut asunder are drawn upwards and downwards into the flesh, by which flesh the mouths of the Veins are compressed and shut, and that so much the more easily because the Blood can move its self so much the more easily through the neighboring veins which are extended and open, the former being shut up, and therefore for the very same cause a small Arterie being cut asunder athwart, neither Bleeding nor Inflammation do follow.

Which things being so, I conceive it is evident to all Men, that such things as happen in Blood-letting, do either prove the Circular motion of the Blood, or at least are not against the same.

No parts receive Blood by the veins excepting the liver. But seeing other Things are objected against us, we must answer them also. And first whereas they prove that the Blood comes through the Veins, not out of the Arteries, but from the Liver: because some parts receive Blood, and have Tumors arising from the Afflux of the Blood, which parts have no Arteries, amongst which they reckon the Pleura. But it does not follow, if the parts have not Arteries, that their veins do not receive their blood from the Arteries, but from the Liver; for as we said, the blood out of the Mesenterick and Celiac Arteries does not enter the Mesenterick and Splenic Veins, through which it is

carried to the Liver: even so other veins may receive blood from the Arteries, which they may carry into a part more remote from Arteries. Howbeit, therein no part of the Body of any bulk, wherein the Anatomists do not rightly acknowledge Arteries to be. And infinite Arteries do not as yet lie concealed from their knowledge, because the smallest Arteries dispersed through the flesh, have only one Coat as the Veins have. Yea, and in the Liver it self, there are so many branches of the *Arteria Cebata*, as there are Branches of the *Vena Porta*, and as many branches also there are of the *Ductus Cholidocus*, all which have bin by Anatomists hitherto reckoned for Branches of *Vena Porta*, because those three kinds of Vessels are in the Liver inclosed in a common Coat. At least no man will ever deny the Arteries of the Pleura, that has once seen the Chest of a living Creature opened; for whilst the Chest is distended, Blood is wont to leap out of the Arteries of the Pleura.

Moreover they prove that Blood does not come out of the Arteries into the Veins, because the Arm being so bound, that the Arteries may still pulse, the Arm is not immeasurably swelled below the ligature, whereas it ought to be so swollen and distended, if by reason of the Ligature nothing can flow back into the greater Veins, and at every pulse, the Arteries drive somewhat into the lower veins, at every contraction, of which Contractions there are more then three thousand performed every hour. Nevertheless, it may come to pass that the Arm is not extended to such a bulk when it is bound; because the veins are not totally shut up, and the blood may by some creeping holes pass under the ligature, and go into the greater veins: as we see a part being closely bound to repel Humors, for divers months or years, is nevertheless nourished by the blood which flows through; also it may come to pass that so little Blood is forced in through the Arteries of the bound Arm, as that it cannot distend, or swell the same under a long time, for that Blood only is forced in, the veins being stretched with fullness, which is in the Arteries from the Ligature unto the Hand: for that which is above the Ligature, can enter more easily into the veins, by open Anastomoses. Yea it may come to pass, when the veins being distended, do no longer permit the Blood to be forced into them by the Arteries, that the pulse of the Arteries is stopped, or that the Blood regurgitates upwards, and enters the Veins above the Ligature, through the Anastomoses: the like whereto I saw in a Duck, as I formerly related. Unless one of these things happen, the Arm would presently swell after it is bound, and a suffocation of the innare Heart, by the Abundance of Blood driven in would follow. For I have often bound mine own and others Armes above the Wrist, and I always saw the veins distended, and the flesh to swell somewhat and grow red; and oftentimes though not alwayes, the arteries abated by little and little of their pulse, yea and sometimes intermitted; and afterward the red colour of the bound Arm was changed into black and blew: and therefore I presently undid the Ligature, being frightened with this Example. A certain Country-man being wounded in the inside of his Arm about the Cubit, when the Village Chirurgeon could not stop the blood, he bound the Arm extrem close about the Wound, whence followed an exceeding Inflammation of the lower part of his Arm, and such a swelling, that deep pits were seen in the place of his fingers joynts, and within eighteen hours, the lower part of his Arm was gangrenated and sphacelated, which *Christianus Regius* an expert Chirurgeon did cut off, in the presence of my self

self, and *Rosalind Scrovelius* an excellent Physician.

Moreover they object, if the venal Blood comes out of the Arteries, how can the arterial Blood differ so much from the venal?

But we must know that it differs less from the venal Blood, then most men imagine, who from the violence wherewith the arterial Blood leaps forth, do collect the great plenty of Spirits therein, and the great rarity or thinness thereof: whereas that Leaping proceeds from the Force wherewith the Heart drives the Blood through the arteries; for an Arterie being opened below or beyond the ligature, the Blood comes out only dropping. And the difference between these two bloods is caused by the greater or less quantity of Heat and Spirits, according as the Blood is more or less remote from the Heart the fountain of Heat. For the Blood which is near the Heart differs much from that which is far off, in the smallest arteries, which you can hardly distinguish from that which is in the small veins. And the smaller veins have more thin and hot Blood, then the great ones; which any one may easily try in opening veins of the Arm and Foot. Yea, and if the Vein be opened with a double Ligature on each side the orifice, as I said before, the Blood will come out hotter then with a single Ligature.

How menstrual Blood is collected about the womb.

Now that the Blood does not go out of the smaller veins into the greater, they endeavour to prove by womens monthly purgations, which according to their judgment, are gathered one whole month together in the Veins about the Womb; and if they are carried from the Womb unto the Head, they conceive that they do not pass through the *Vena cava* and the Heart. Howbeit, the common and true opinion is, that about the time of the usual flux, the blood begins to be moved to the Womb, from which motion of the humors, pains of the sides and loines are wont to arise about that time. And I know by Experience, that about the time of the menstrual Flux, if the Pulse of the Heart and arteries can be made greater, the Courses will flow the better, because the Blood will through the arteries be driven more forcibly into the Womb. It may nevertheless fall out, that the Courses may be collected and make an Obstruction in the Womb, and that then the Blood may not return into the greater veins, that motion being stopped: but that is besides nature.

How they are carried out of the Womb into the Head.

And when the menstrual blood is carried out of the Womb into the Head, the way is not inconvenient, through the *Vena cava*, the Heart, and the ascending branch of the *Arteria Aorta*, and that they do indeed pass through the Heart, those palpitations and light faintings do seem to argue, which are wont to attend upon the Courses stopped.

But should we not conceive it to be a dangerous thing, if all the ill humors in our bodies must pass into and through the Heart. But we must know, that our bodies

are so framed, as that they may be most convenient for us when we are in Health, and not when we are sick. Moreover the Humor which putrifies by reason of obstruction and is very bad, comes not to the Heart, because its way is stopped up. Nor is the Heart so weak as to be corrupted by an evil Humor, which

stays not long therein: for those great Physicians *Galen*, *Helliorius*, *Laurentius* have observed, that the Quinter of such as have an Empyema, and other sharp and stinking Humors, do critically and without any bad symptoms, pass through the left ventricle of the Heart, which many times makes for the good of the sick Persons, in whom that bad Humor passing through the Heart, is often vanquished by the Vigour and Virtue hereof.

The other Objections which they make, do only respect the Causes of this motion or certain Circumstances, wherein men are wont more freely to dissent, yet let us briefly consider whether or no they have in them any weight, wherewith to burthen our Opinion.

They say that at every contraction of the Heart, the blood is not driven out by half ounces, nor by drams, nor by scruples; out of the Heart of a Man, for three Causes: first because that blood is too spirituous, but I have already shewed that it is not so spirituous as men imagine commonly: secondly because those little Valves of the Heart, do only gape a little, and then are close shut again, which also doth not agree with experience: for an Arterie being cut off from the heart, great streams of Blood do issue from the Heart. Thirdly that the Arteries are too full then to be able to admit half an ounce, a dram, or a scruple of Blood. But that is too inconsiderately avouched; for when the Heart contracts it self, all the arteries in the body are enlarged, and that on all sides, as I have divers times perceived with my hand, holding the naked arterie betwixt my fingers. And who will now say, that all the Arteries of the Body being dilated, cannot admit of a Scruple, a Dram, yea half an Ounce of blood, more then they have?

Also they deny that in the child, the blood out of the *Vena Cava*, does through the Vessels of the heart united enter into the *Arteria Aorta*, and go from thence out of the umbilical Arteries into the umbilical Vein, and return back by it into the Heart: because they think this great absurdity will follow, that one Vein should carry the mothers blood and withal so much blood as the two umbilical arteries do bring in. As if Rivers did not frequently carry as much water in one Channel, as many Brooks are able to bring in. And here the umbilical Vein when it is, but one, is much greater then the Arterie. There is often but one arterie or there are two veins; that the arteries may as much as may be answer to the veins.

In brute Beasts, (*scilicet Fallopius a rare Anatomist*) there are always two Veins and two Arteries, which with the *Vrachus* or *pif-pipe* do reach as far as the Navil, and the Veins do presently grow into one before they enter into the Abdomen which does reach to the Gates of the Liver, as I have observed in all Sheep, Goats, and Cows, whose young ones I have dissected. But if they speak of the Child in a Womans Womb, I avouch that sometimes I have not seen the two umbilical Arteries, but only one Arterie and one Vein ascending together with the *Vrachus* to the Navil: where the Arterie is again divided into two, which afterwards go unto the sides of *Os sacrum*. And that indeed those Vessels of the Heart are united in a Child in the Womb, that the blood may pass that way out of the *Vena Cava* into the *Aorta*, Waterfowl, as the Duck, Goose, and such like do seem to teach us;

The Objections against circumstances.

Nothing hinders, but that half an ounce of Blood may be forced out of the Heart, at every pulse.

Nothing hinders, but that the Blood may be circularly moved in the child.

A sign that it is so indeed.

whieti

which because they cannot often breathe under the water, nor dilate their Lungs; nor consequently admit the blood that way, they have those unions of the vessels of the Heart, when they are grown up. Which also Harvey notes in his 6. Chapter.

Also they deny the frequent Anastomoses of the Veins and Arteries; for if such there were, they say tumors would not arise by Fluxion and Congestion of Humors. As if Rivers though they have outlets, receiving over-great plenty of water, may not

overflow the neighbouring fields; nor can the blood shed out of the Vessels, because it congeals, easily return into them again. Moreover Tumors are many times caused, for as much as by reason of Obstruction, the bloods passage is stopped; and because by heat and pain it is drawn into the flesh.

Now those Tumors seem rather to favour the Doctrine of the bloods circular motion, because they happen through cold, bruising, and all stoppage of the passages of the Body; and because with *Aqua vite* or some such medicine, the Humors and the Tumors being often made fluid, it is by this motion of the blood drawn into the Veins; and the Tumor by that means sooner cured then by repulsion, revulsion, concoction or dissolution.

Touching the Cause of the Bloods motion; difficulties do also present themselves unto us; and when we deny that the blood according to the Course of Nature, is so suddenly and vehemently rarified in the Heart, as to be able to move the Heart; the blood of the whole Body, and the Arteries themselves; those famous men the Ring-leaders of this opinion, do suppose that they do hereby prove it. In that while we are cold, all the Veins of our Body are contracted, and can hardly be seen, where as after wards when we grow hot, they do so swell, that the blood contained in them, seems to take up ten times so much space as before it did.

As for me, this truly is my Opinion, and thus I persuade myself, that seeing they have now divers times, so diligently endeavored in Publick to persuade men to embrace this their Opinion of Rarification; and have dissected and lookt into the Hearts of Living Creatures, nor have yet dared to say, that they could sensibly perceive any such Rarification of the blood in the Heart; I say, my Opinion is, that they could not indeed and in truth observe any such Rarification of the blood in the Heart, and as they would in this place maintain: And it will be easie for him that is a little versed in live Dissections, to see that there is no such rarification. And therefore though it might be proved, that such a Rarification of the blood, does sometimes happen præternaturally, yet ought not the cause of the Natural motion of the Heart, Blood and Arteries be therefore attributed thereto.

Yet in the Example which they propound, I do not see what certainty there is that the blood by reason of its Rarification does possess ten times more space then before. For might not that same Tumor of the external Veins easily arise, because whereas before the veins were contracted and straitned through cold, they could not receive much blood; and therefore they could not swell: Which cold and straitning of the vessels being afterwards taken away, and the Veins being loosned by heat, they might admit much blood, which is driven into them by the heart, and so appear full and swelling. That this is not the least cause of the tumor of the Veins, persons that are feaverish seem to teach us,

who if they thrust their arms into the cold, have not their Veins so swelling, but if they keep them warm under the cloaths, they have them very full and swollen, which tumor if it came from Rarification, it ought to be in both cases alike, seeing that in them, the bloods Rarification proceeds from an internal cause.

Nor do I conceive that it is also void of Question and undoubted, that when we are first cold, and afterwards grow hot, the inner Veins as well as the outer do swell. For it is much to be suspected, that the inner parts do possess less blood and heat before, because by that cold wherewith before they were not hurt; if when we are so heated we drink cold drink, they are wonderfully weakened. Doubtless as the inner veins are oftentimes the treasury of the blood, wherein the blood is stored up for future uses, so may the external Veins be the like treasury, and they appear to be when they so swell as aforesaid.

These men themselves when they observed that this also was much against their Opinion, that we asserted that the blood was manifestly poured out, at the constriction of the Heart; they avouch that that is not the constriction, but the dilatation of the heart which we mean. But that we were deluded by a certain appearance, because in our constriction, there was a constriction only at the Basis, but about the tip a true Dilatation; which Invention when others saw that it could not hold, least they also should seem to desert their cause, they invented that there is a constriction indeed, in the Cavity of the whole Ventricle, but in the pits and passages of the sides, especially in Dogs, there is a certain kind of Extension and true Dilatation.

But truly, the upper part of the Heart is not seen to be dilated, when the lower is contracted; save when the Creature is dying; and that the waving motion of the Heart is caused by the impulse of the blood. Nor can we observe one Dilatation or Constriction of the Pits, another of the Cavity of the Ventricles. Only a certain progressive motion is observed in a large Heart, because the Dilatation or constriction doth evidently begin at the basis, and sensibly proceeds to the tip, although 'tis performed all welnear in a moment. And that I might be perfectly assured, that the Heart was contracted within likewise, on all sides, having cut off the tip of each Ventricle, I put my thumb and fore-finger into the living heart of a Dog and a Rabbit; and I manifestly felt the sides of the Heart to press my fingers to the middle partition, equally in the middle, tip and Basis; and that the pits in greater Beasts, became to Sense, not bigger but lesser. And soon after the Constriction abating, that the sides of the heart above, beneath and in the middle were loosned, and the pits did feel evidently larger. But in the Septum or partition wall it self, no motion is felt, save that the Spirits seeking egress make a kind of Palpitation, when in Creatures at the last gaspe, the motion of the right Ventricle ceases, the Septum follows the motion of the right Ventricle.

Now they would have it nevertheless that naturally the blood is poured out in the widening of the heart, and not in the Constriction or straitning thereof, because in the wounded Heart of Living Creatures, the blood is seen to come out when the Heart is dilated. And this is sometimes true; but that which they thence collect, our very Senses reach us to be untrue. For either the Dog or other creature is placed with its Head and breast elevated, and the

But by constriction of the heart the blood is driven in the Arteries.

Not in the dilatation, though sometimes blood go out therein.

the belly low, and so the wound is inflicted into the Heart, in which case, seeing the blood which enters through the *Vena cava* and *Arteria venosa* into the Heart, is higher then any wound of the Heart, it, as soon as it is entred, which is at the beginning of the Dilatation, flows out, not because of the Pulse, but of its own heaviness, and therefore it is not by any force made to flie out to some distance, as it happens in the Pulse of the Arteries. But if as it ought to be, the dog be laid on his back, his head and belly resting on the same plane, and the wounded Heart be raised with a mans fingers, as long as there is any strength in the Heart, it sooner by Constriction casts out the blood it hath received, at a distance, then the whole Heart is filled or widened. But when the strength of the heart decays, and that it seldom straitens it self or not at all, because the Earlets are more strong, and do still continue pulsing, even when the Heart quite gives over; the blood being driven by the Earlets enters the heart, is there collected, and when more is come in then the Heart can contain, it goe out at the wound, not with violence, as it must do to cause Pulsation, but with a gentle motion, drop after drop. So that our Sense can perceive no strong motion of the blood, save in the Hearts Constriction.

And being driven by all parts of the Veins, it returns to the Heart.

Now they will have the blood to return through the Veins into the Heart, only because the blood being forcibly driven to the Parts, as water poured into an horn, does regurgitate or rebound back upwards, and so is carried back unto the Heart. But I have already shewed tokens, that the blood is either drawn, or driven by all the parts of the Veins: besides which I have also these following: in that the Heart being taken out of the body, the motion of the blood, and that swift enough, is still seen in the Veins. And if a Vein, yea a milkie one, be tied in two places, that same Ligature being only loosned, which is nearest the Heart, while the parts are yet hor, the Chyle will still be moved to the Liver, the blood unto the Heart, which could neither by any step be driven from the Heart through the Arteries, nor from the Guts through

the *Vena lactea*; nor would it by its own fluidity move rather upwards then downwards.

But let us answer the remaining objections: They suppose, if the blood should be moved so swiftly, that the Veins and Arteries could not conveniently be nourished. But a dog can quench his thirst, drinking at the River Nilus and running as he drinks; but here the parts stay at the brook side: and whatever they have drawn from the blood, they treasure up in their own substance, least it should be washed away, by the running by of the humor.

Also they conceit this Motion is not useful for the blood. Seeing it may sufficiently be conserved (since it abounds with native heat) by respiration and transpiration. Yet most certain it is, that the blood is yet more ventilated, if it be speedily moved, and its smallest Particles also agitated with this motion. So the water of a lake or standing pool, though it be gently moved and fanned on the Surface, yet is it corrupted; when in the mean while Rivers that are totally and in all parts agitated, are found to continue most uncorrupt and wholesome.

And the blood ventilated better.

These are the things (most excellent *Bartholine*) which I thought fit to joyn to the former, that I might satisfy those who cannot receive a new opinion, wherein they observe any difficulty or obscurity; who many times have neither mind nor time to enquire exactly into the bowels thereof. But in my Judgment, we ought not to deny things manifest, although we cannot resolve such as are difficult.

But I never was disposed to contend and quarrel with any man about words. There are very many excellent things about which time may be spent; which many times also is not sufficient for our necessary occasions. Also from a Scoffer that seeks after her, Knowledge does hide her self away, but to him that is studious of the truth, she comes to meet, and presents her self to his view. Farewel most Learned *Bartholine*. From the University of *Leyden* in *Holland*, the Kalends of *December* 1640.

FINIS.